THURSDAY, SEPTEMBER 17, 1914.

THE CRETACEOUS FLORA.

Catalogue of the Mesozoic Plants in the British Museum (Natural History). The Cretaceous Flora. Part i., Bibliography, Algæ and Fungi. By Dr. Marie C. Stopes. Pp. xxiii + 285 + ii plates. (London: British Museum (Natural History): Longmans, Green and Co., 1913.) Price 12*s.*

DR. MARIE STOPES set herself a severe task in deciding to include in the catalogue of Cretaceous plants an exhaustive bibliography and list of species. The list of species from Cretaceous beds, described up to December 31, 1910, occupying nearly two hundred pages, affords a striking illustration of the large amount of material in palæobotanical literature that serves no useful purpose. While acknowledging that a list of this kind is valuable as a source of information, it is difficult to repress a certain suspicion that the result obtained is scarcely a fair return for the labour expended. As Dr. Stopes continues her investigations the value of the list will be considerably increased by the addition of critical remarks on such of the records as come under her purview. As it stands the catalogue of names may mislead the unwary who have not learnt by experience to regard with distrust a large proportion of determinations based on fragments of fossil Angiosperms; but as a storehouse of bibliographical information the list will be of real service to students. In the Introduction Dr. Stopes gives a useful summary of literature dealing with Cretaceous floras, and the stratigraphical table is a particularly welcome contribution which will do much to clear up the confusion caused by the adoption of different terms for subdivisions of the Cretaceous system in different countries. The publication of a list of dates of the parts of Brongniart's "Histoire des végétaux fossiles" is a much needed step towards a greater uniformity in systematic work: in the preparation of this bibliographical note the author expresses her indebtedness to Mr. C. Davies Sherborn.

The latter part of the catalogue is concerned with descriptions of Cretaceous thallophyta, in many instances accompanied by helpful illustrations. The author restricts the use of the generic name Algites, proposed in 1894 in a comprehensive sense for fossils which cannot be referred with any degree of certainty to a particular recent genus or family, to *flattened* impressions, and employs Sternberg's designation Chondrites for "algæ, or fossils which suggest algæ, with a much-branched dichotomous or sympodial thallus which is *cylindrical*." Having regard to the worthlessness, from the point of view of relationship to Chondrus, of most of the fossils referred to Chondrites, it would seem preferable to discard the name in favour of a general designation such as Algites if used in the wider sense in which it was first proposed. The concise summary of the characters of several types of algæ belonging to the Siphonaceæ and the Rhodophyceæ will serve to direct attention to the possibilities of a neglected branch of palæobotanical research. Among the fungi included in the catalogue the two most interesting are the Japanese species, *Pleosporites shirainus* and *Petrosphaeria japonica*, the former being represented both by perithecia and septate vegetative hyphæ.

Dr. Stopes carries into practice her suggestion (*Annals of Botany*, 1911) that "all fossil plants for which there is no good, scientific reason for association with given families and genera, and to which, nevertheless, names indicative of such affinities have been given, should be printed henceforth in Gothic characters." If this plan were adopted in the list of Cretaceous species in the first part of the volume as well as in the descriptive portion, very serious demands would be made on the printer's Gothic fount. It is doubtful whether this method will find favour: the use by palæobotanical writers of designations implying affinities that are assumed on wholly insufficient grounds seriously detracts from the value of published lists; but, it may be urged, the better course would be to discard the misleading names rather than to dignify them by the employment of Gothic letters. Moreover, this attempt to institute an *Index Expurgatorius* is based on an individual opinion and has not the sanction of supreme authority.

Dr Stopes has made an excellent beginning: the less interesting and more laborious work has been accomplished, and we confidently expect that the later volumes will add greatly to our knowledge of the vegetation of a period which is of exceptional importance. The flora of the preceding Wealden period is, in its general facies, a continuation of the Jurassic floras: flowering plants had undoubtedly been evolved, but they occupied a subordinate position and, so far as we know, were unrepresented in the Wealden flora of Britain. It was in the succeeding stages of the Cretaceous system that this remarkably successful group rapidly rose to the position of dominance that it now occupies in the floras of the world.

A. C. SEWARD.

ELECTROSTATICS AND MAGNETISM.

A Text-book of Physics. By Prof. J. H. Poynting and Sir J. J. Thomson. *Electricity and Magnetism.* Parts i. and ii. *Static Electricity and Magnetism.* Pp. xiv+345. (London: Charles Griffin and Co., Ltd., 1914.) Price 10*s.* 6*d.*

THE late Prof. Poynting's qualities as a physicist are reflected in the volume on electrostatics and magnetism now before us, for he was always distinguished by soundness and clearness of thought, and care and accuracy of experiment rather than by showy brilliance. The book is very clearly written, and evidently no trouble was spared in the attempt to make it as easily understood as possible. A large part of it is, in fact, a model of exposition, and could scarcely be improved upon. The chief value of the book, however, lies in the fact that it goes a little farther than the ordinary elementary text-book has done up to the present. Most English text-books deal in a very cursory way with both electrostatics and magnetism, and it is extremely useful to have a book which gives a somewhat more adequate treatment without at the same time becoming too difficult and exhaustive.

The chapters on "The Dielectric," "Specific Inductive Capacity," "Stresses in the Dielectric," "Alterations in the Dielectric," and "Pyro-electricity and Piezo-electricity," are particularly good in the "Electrostatics"; and those on "Forces on Magnetised Bodies," "Paramagnetic and Diamagnetic Substances," and "Magnetism and Light" in the "Magnetism." The simple statement of the titles of these chapters will give a clue to the difference between this text-book and others. All the extra matter is quite important, and in no way abstruse, yet a considerable part of it is not to be found in any other English elementary text-book. The great value of the book to students is therefore obvious, and is scarcely lessened by the few defects which exist.

The first and most serious of the faults of the book is the inconsistency with which previous knowledge in the student is assumed. The first chapters in both the electrostatics and the magnetism are written as if for students with absolutely no previous knowledge of the subjects, while to understand the chapters on magnetic induction a student would require a reasonable knowledge of the magnetic field due to a current. In a book of this character it would seem that the most reasonable assumption to make is that the knowledge of the student is of about the intermediate science standard. The extremely elementary general accounts of the common phenomena could thus be omitted, and one could start without any preamble on the more important part of the book.

The order in which the various divisions of the subject are taken is rather strange in places. It seems the reversal of the proper order to give a number of the consequences of an inverse square law of force in one chapter and to give the experimental proof of the law in the following chapter, but the most flagrant case is the attempt to give a general account of susceptibility, permeability, and the hysteresis loop before any of the magnetic quantities have been defined. To an elementary student these things would be very confusing, but as there is no doubt that all students who come to this book will bring with them a fair working knowledge of the most elementary parts of the subject, very little harm will be done.

A few not unimportant matters of detail might also be improved. There are two totally different definitions of quantity of electricity, one on p. 29 and one on p. 67. It is true that these two are consistent with one another, but this is not proved, and the first definition is quite unnecessary and is nowhere used. The definition on p. 42 of the electric potential at a point as $\frac{\Sigma Q}{r}$ seems to be converting potential into a mathematical symbol with no direct physical meaning. If we define the difference of potential between two points as V when the work done in taking an indefinitely small quantity dq from one point to the other is $V.dq$, we not only have the physical conception of work per unit quantity but we can also define any other kind of potential in an exactly similar way.

It is also desirable that Franklin's jar with its movable coatings should be given a long-deserved rest. It does not prove, what it was originally supposed to prove, that the seat of electrical action is in the dielectric; it merely proves that glass is a very bad substance to use as an insulator, because it so readily forms a conducting layer on its surface by the absorption of moisture from the atmosphere. A Franklin's jar made with a good insulator does not work, and therefore there seem to be no reasons for introducing it.

Most of the diagrams are very clear and suitable; they are of good size and are simplified as much as possible. But Fig. 194 on p. 250 offends the eye of a physicist just as keenly as a note badly out of tune offends the ear of a musician. One scarcely expects all the diagrams of lines of force and equipotential surfaces to be drawn accurately to scale, but one does demand that lines of force and equipotential surfaces shall not be palpably inclined to one another as they are

in this diagram. This certainly should be altered before a new edition is printed.

Although it takes a good deal of space to point out these defects, they are not numerous or important enough to decrease the value of the book sensibly. It is scarcely necessary to advise students to get the volume, as they will find it indispensable if they wish to obtain a good working knowledge of the fundamentals of electrostatics and magnetism. P. P.

BOTANY AND NATURE STUDY.

(1) *Introduction to Botany.* By J. Y. Bergen and Prof. O. W. Caldwell. Pp. vii + 368. (Boston and London: Ginn and Co., n.d.) Price 5*s*.

(2) *A Flora of Norfolk.* Edited by W. A. Nicholson. Pp. vii + 214 + 2 maps. (London: West, Newman and Co., 1914.) Price 6*s*.

(3) and (4) *Wild Flowers as They Grow.* Photographed in colour direct from nature by H. Essenhigh Corke. With descriptive text by G. Clarke Nuttall. Sixth series. Pp. viii + 200 + plates. Seventh series. Pp. viii + 204 + plates. (London: Cassell and Co., Ltd., 1914.) Price 5*s*. net each.

(5) *The English Year: Spring.* By W. B. Thomas and A. K. Collett. Pp. ix + 334 + plates. (London and Edinburgh: T. C. and E. C. Jack, n.d.) Price 10*s*. 6*d*. net.

(6) *My Garden in Spring.* By E. A. Bowles. Pp. xx + 308 + plates. (London and Edinburgh: T. C. and E. C. Jack, 1914.) Price 5*s*. net.

(1) THE authors of this excellent elementary text are practised hands in the production of books on botany for students, and the present work is mainly a condensation of their larger work published a few years ago, entitled "Practical Botany," though from the abbreviated list of their works on the title-page one might infer that *each* author had published an earlier book with this name. However, it differs considerably in style from the authors' previous works, and indeed from most other elementary books on botany, in two features which are consistently kept in view throughout—namely, the emphasis which is laid on the dynamic side of botany, the plant being regarded as an organism forced to maintain its existence under conditions sometimes favourable and sometimes unfavourable to it, and the constant reference to the practical side of plant life in all its bearings. That is, while the work gives a good general grounding in botany, the ecological and the economic aspects of the subject, taken in the widest sense, are never lost sight of and at the same time are not unduly stressed. Since there are comparatively few references to plants unknown in the wild state or unfamiliar in cultivation in Britain, the book is one that can be warmly commended to teachers, at any rate to those who have no set syllabus to work from, while those responsible for the framing of syllabuses in elementary botany might learn much from a book like this as to what is wanted in the case of a subject with such marked educational significance. The book is generously illustrated, and the figures are remarkably clear and well executed.

(2) The Norfolk and Norwich Naturalists' Society is to be congratulated on the production of this admirable flora of a remarkably interesting county, a book which was certainly required, considering that the only previously published Flora appeared so far back as 1866 and has long been out of print. The editor of this work has left no stone unturned in his efforts to make the lists of the flowering plants and the higher flowerless plants of Norfolk as complete as possible, while he has enlisted the services of other writers in the earlier part of the book, dealing with climate, soils, physiography, and plant distribution, which precedes the plant lists. Both sections of the book are, however, open to a certain amount of criticism. While the articles on climate and on soils are all that could be desired, being admirably clear though brief, that on physiography and plant distribution is rather weak as regards the latter or vegetational aspect, though the part dealing with physiography is good so far as it goes. The author of what ought to be the most important portion of the general discussion of the flora of a county or other area fails to arrange his subject-matter clearly and logically, and his treatment of the ecology and distribution of the flora will, we fear, be useful neither to the average field botanist unfamiliar with the terminology or the ideas of modern ecological plant-geography, nor to the ecologist desiring to compare the vegetation of Norfolk with that of other parts of the country which have been systematically investigated from this point of view. In a flora of this kind, the general account of the vegetation should be preceded by an outline of general ecological principles, with an indication of the relations of the plant-communities represented in the area to the general scheme upon which these communities are based and classified. Again, in the systematic portion of the work, following on the flowering plants, we find the heading "Cryptogamia," but the list of flowerless plants stops short with the mosses and liverworts; either such a heading

should not be used, or the entire flora, including the lower cryptogams, should be dealt with.

(3, 4) Like the previous volumes with photographs in colour of British wild flowering-plants by Mr. Corke, and descriptions by Mr. Nuttall, these two series are extremely attractive books, though the text is, as before, less arresting than the plates, most of the latter being remarkably fine. The work is, however, intended for popular reading, and that it serves a useful purpose is shown by the mere fact that seven volumes, dealing with upwards of two hundred species, have now been issued. The number of the volume is indicated in each case by the curious device of a constellation of asterisks below the authors' names on the outside cover, but surely ordinary type would have been better than this. It is to be hoped that the authors will, in the further volumes of this series, include various flowering plants which, though devoid of conspicuous flowers and therefore less suitable perhaps for colour photographs, are of interest in other ways, as showing special adaptations of the vegetative organs for life in special habitats; if a few such plants were treated in each volume, the value of the latter for the drawing-room table would not be appreciably lessened, while their usefulness in other ways would be enhanced.

(5) The general get-up of this book, the post-impressionist style of a considerable proportion of text and coloured illustrations alike, and the extraordinary badness of the black-and-white figures, all combine to produce a loose, untidy effect which is evidently intentional, and intended for something very fine and striking, which somehow misses fire. The text is often sprightly and readable for a while, than one comes across pages of rhapsody and rubbish; sometimes we get really good observations and new points of view, but soon we are back to loose writing and absurd mistakes in the most elementary facts of plant and animal life. The book consists of a series of essays on a variety of topics more or less relating to the phenomena of springtime, and most of them give the impression of having been expanded, often by the interpolation of long bits of poetry, from articles written for the newspaper Press and kept within bounds by the exigencies of space in their original form. Much of the text is slovenly, will not bear parsing, to say nothing of scientific criticism; but probably it is only through careless proof-reading that the authors, after asking what are the most hackneyed lines on springtime, proceed to quote "Browning's 'O to be England,'" adding that "the lines are trite"—but any lines can be made less so when suitably treated.

(6) Here again the subject is spring, but with a difference. Mr. Bowles writes as one having authority on all gardening matters, and here he is perhaps at his best. He takes us through the kaleidoscopic pageant of spring in his garden, acting as guide, philosopher, and friend, dropping casually many valuable hints for those of his readers who would aspire to possess a garden with even a tithe of the rich collection he has brought together in his, and relating some amusing stories on the way. One of his chapter titles is somewhat startling—"The Lunatic Asylum"—and made us apprehensive of another excursion into very wild life, but after all it was only a piece of wild garden and the many and varied plants that were allowed to riot in it, so by way of "Tom Tiddler's Ground" we are brought back again into the Iris Walk, the Rock Garden, and so, with regret, to "The Culmination of Spring" and the end of a thoroughly delightful conducted tour. F. C.

OUR BOOKSHELF.

Marine Engineering (*a Text-book*). By Engineer-Captain A. E. Tompkins. Fourth edition, revised and partly rewritten. Pp. viii+812. (London: Macmillan and Co., Ltd., 1914.) Price 15*s*. net.

DURING the six years which have elapsed since the publication of the third edition of this book, marine engineering has made great progress, and the author has taken the opportunity of bringing the present edition up to date. Thus we find new matter giving account of recent turbine practice, including the power transmission and speed-reduction devices of Parsons, Föttinger, and others. The sections dealing with the internal combustion engine are now fairly representative of modern practice, and contain descriptions of both two-stroke and four-stroke Diesel engines. A great deal of attention has been given to condenser plants during the past few years, and the author has not overlooked the work and experiments of Mr. D. B. Morison, Dr. Weighton, and Messrs. Weir. The section on the use of liquid fuel in boiler furnaces is also very complete.

The book is intended primarily for sea-going engineers, and there must be very many such who can bear testimony to the value of the previous editions, and who will welcome the book in its present form. The descriptions and drawings are exceptional for their clearness, and while the calculations given are of the simplest character, sufficient of the theory is stated in all cases to enable the engineer to have an intelligent understanding of the machinery under his charge. The sections dealing with care and management of boilers and machinery, and with the duties of the engineer of the watch, are very useful, and will be of service to other than marine engineers.

The Examination and Thermal Value of Fuel: Gaseous, Liquid, and Solid. By J. H. Coste and E. R. Andrews. Pp. xvi+278. (London: C. Griffin and Co., Ltd., 1914.) Price 6*s.* net.

THE importance of the scientific examination of fuels and the avoidance of wasteful methods of utilisation is becoming more and more recognised as it is realised that economy, both individual and national, must be exercised in their application. This small treatise deals with the methods of sampling, analysis, and determination of the calorific value of fuels of all classes, and the examination of flue gases.

The book will prove of considerable service in the laboratory, but it must be confessed that in some sections it is lacking in that personal assistance, the result of experience, one is led to hope for in the preface.

In gas analysis, for example, many are the pitfalls besetting explosion analysis, but beyond the usual outline of procedure, little help is given in avoiding the difficulties. Again, whilst the Petroleum Act regulations for testing the flashing point of burning oil (which is of minor importance as a fuel) are quoted *in extenso*, the flash point of heavier oils (those of special importance as fuel oils) is dismissed with the briefest description of the Pensky-Martens apparatus, and no description of the method of working is given or reference made to the precautions necessary to obtain good results.

The sections on calorimetry are undoubtedly the most satisfactory portions of the book, with much evidence of personal experience. Very ample consideration is given to questions affecting the accuracy of the results and the comparative value of different types of calorimeters. Now that purchase on calorific value is becoming more general and legal standards of calorific value of gaseous fuels already established, the whole subject of calorimetry has become of primary importance, and this book is certainly a useful addition to the literature on the subject.

Rapid Methods for the Chemical Analysis of Special Steels, Steel-making Alloys, and Graphite. By C. M. Johnson. Second edition, rewritten. Pp. xi+437. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1914.) Price 12*s.* 6*d.* net.

THE first appearance of this book dates back to 1908, and the edition now brought out contains quite twice as much material as its predecessor. The chapters have increased from sixteen to twenty-one, whilst the subdivisions of chapters, which were so strange in the first edition, are still further elaborated. The new chapters deal principally with the analysis of ores, refractory materials (acid and basic), fluorspar, lubricating oils, and coal; whilst uranium, cobalt and nitrogen are added to the section on steels. Besides these the chapter on the determination of carbon is amplified considerably, and an interesting account of the estimation of oxygen in tungsten powders and in steels has been inserted. The valuation of nickel chrome steels and Monel metal have been given chapters to themselves. Unfortunately, the new portions (which deal practically entirely with the author's own work—the general literature being rather neglected) have been inserted in such a way as to give the book a very patched appearance. The arrangement has also resulted in several rather tiring duplications. A blue pencil wielded by a friendly though very free hand would have tended to a much improved book. In a work of this nature one naturally looks for all things up to date, and in consequence one is surprised to find no appreciation of the "reductor methods" that are so extremely useful in analysis of this kind. Among many other omissions may be mentioned the work of Gooch and his pupils on vanadium, molybdenum, etc., the recognised volumetric methods for manganese in ferro-manganese, the ignition of Brünck's precipitate to nickel oxide, and the iodometric estimation of copper.

LESLIE AITCHISON.

The Latest Light on Bible Lands. By P. S. P. Handcock. Second edition, revised. Pp. xii+371. (London: S.P.C.K., 1914.) Price 6*s.* net.

ARCHÆOLOGY is a two-edged sword for those who would "prove the Bible," an uncertain lamp which may unexpectedly throw a distressing light on the mental calibre of chosen races; nay, more, traditions of similarities in Flood-narratives, or divergences in Creation-stories, may not unnaturally set up doubts in credulous minds as oppositions of science falsely so-called. It was one of the discoveries of Macalister at Gezer that Philistinism was a misnomer for boorishness, for the Philistines by the traces of their culture and civilisation there discovered have proved themselves to be far more worthy artists than the Hebrews. Mr. Handcock's book is of a kind which is published from time to time, giving the latest discoveries so far as they are analogous to the Old Testament, and recapitulating what was hitherto known. Here is again the Babylonian account of the Flood and the Creation of Man by Marduk from his own blood (why is no reference made to Mr. King, who first published the tablet containing the latter story?); an account of the Gilgamish epic and the Flood-story, told sufficiently accurately in their main points, although the distinction which the author makes in the epilogue is too nice for us ("'the gods came down to smell the sacrifice like flies,' a description which in its materialism contrasts somewhat strikingly with the dignified words of the Biblical writer, 'And the Lord smelled a sweet savour.'"); and a proper rejection of the Chedorlaomer theory. The chapters on the latest diggings in Palestine form a useful *précis* of what has been published by excavators, and Mr. Handcock gives also a full index of Old Testament place-names. In judicious hands his book will go far to provide a guard against one edge of the sword; it has been the writer's endeavour to allow the facts to speak for themselves.

R. C. T.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Age of a Herring.

THE very remarkable conclusions which Dr. Johan Hjort has drawn from his study of the scales of herrings are discussed, over well-known initials, in NATURE of August 27. Your contributor is evidently convinced of the truth of Dr. Hjort's deductions, and this opinion is shared, I believe, by very nearly all those biologists who make a study of fishery questions. Nevertheless, even in face of this general consensus of opinion, I am unable to persuade myself (on the evidence at present in hand) of the validity of Dr. Hjort's conclusions. The leading statements made by Dr. Hjort and his friends are these:—(1) That the age of each individual herring, or the year in which it was born, is at once made known by the number of rings upon its scales; (2) that, *ipso facto*, the shoal can be at once analysed into its component "year-classes"; and (3) that herring spawned in 1904 (according to such evidence) were so prodigiously numerous that year after year they have seemed to dominate the Norwegian herring-catch, and have constituted from 77 per cent. to 54 per cent. of all the Norwegian "spring herring" during at least the five years from 1910 to 1914.

To attempt to deal in a few words with all Dr. Hjort's careful work and laborious arguments is, of course, out of the question; but let me try to say as shortly as possible why I find it hard to follow him.

The whole argument depends on the primary assumption that the age of each herring is marked upon its scales, year for year, ring for ring. This is still a hypothesis. That there is no little circumstantial evidence in its favour I readily admit; but it has never been proved, and is only acceptable so long as the deductions to which it directly leads are themselves intrinsically acceptable.

Now if we sample at random a shoal of herrings, and analyse them acording to their scale-rings into so-called "year-groups," we find that these numbers range themselves with great apparent regularity in a unimodal skew-curve: just as the same fish group themselves also, according to size, in a unimodal but more normal curve. Here is one of Dr. Hjort's own samples, reduced to percentages as he himself gives it:—

"Age-groups," or Number of Scale-rings, in a Sample of 635 Herrings from the Dogger Bank (1910).

Number of rings	2	3	4	5	6	7	8	9	10	11	12	13
Presumed year of birth	1908	1907	1906	1905	1904	1903	1902	1901	1900	1899	1898	1897
Per cent. number of fish	0·2	8·4	14·2	21·3	18·9	14·3	9·3	5·7	5·5	1·3	0·8	0·3

Now, to say the least of it, it seems to me statistically improbable that a dozen separate generations of herrings, spawned in as many years, should have entered into the formation of the composite shoal in these curiously and regularly graded proportions. On the other hand, were we to assume that these herrings were *all of the same age and origin*, then we should have at hand an easy explanation of the facts, viz. that just as the individual herrings vary in a normal fashion about a certain modal size, so do they also vary, in the number of their scale-rings, about a certain modal number.

The rings on an oyster-shell are not just the same things as the rings on a herring's scale, but yet the analogy is not very remote. Miss A. L. Massy has lately made a study of oyster-shells, using oysters *of known age* from the hatchery at Ardfry. I extract from her data the following table:—

Analysis of a Sample of 341 Three year-old Oysters according to the Number of Shell-rings.

Number of rings ...	2	3	4	5	6	7
Number of oysters ...	16	169	94	48	12	2

That is to say, in the case of the oyster the number of shell-rings does not correspond to the years of the oyster's age, but, on the contrary, is subject to variation according to regular and simple law. And the variability of the shell-rings in a sample of oysters all of identical age is in a very close degree similar to that of the scale-rings in a sample of herring drawn from one and the same shoal. The simple and crucial question is, then, whether in a shoal of herrings the evidence tends to show that all the fish are of one and the same age, like Miss Massy's oysters, or whether the shoal is a mixture of many generations, as Dr. Hjort asserts.

When we come to Dr. Hjort's final deduction, we find it illustrated, as your contributor tells us, by the following table, showing the manner in which successive "year-groups" of herring are said to have combined to constitute the Norwegian adult herring population of 1914:—

Spring Herring, 1914 (2205 Fish Examined).

Age (or number of scale rings)	Presumed date of Birth	Per cent. No. of fish
4 years	1910	0·6
5 ,, ...	1909	3·3
6 ,, ...	1908	6·9
7 ,, ...	1907	5·2
8 ,, ...	1906	7·2
9 ,, ...	1905	13·9
10 ,, ...	1904	54·3
11 ,, ...	1903	5·0
12 ,, ...	1902	1·5
13 ,, ...	1901	1·2
14 ,, ...	1900	0·4
15 ,, ...	1899	0·5

If we accept part of what this table sets forth, we must accept the whole. If we believe that the adult herring population consisted, to the extent of 54 per cent. of its total numbers, of herrings born in 1904, we must also believe that the remaining 46 per cent. was constituted of some eleven other successive yearly broods, all so nicely graded as to their proportionate amounts that these latter form an all but smooth curve, rising up to and falling away from the modal group of ten-year-old fish. Any normal population, as of men, consists, of course, of individuals of all ages, less and less numerous the greater their age. If there be, as among herrings there well may be, large and irregular fluctuations in the annual birth-rate, then the descending age-curve of the population would be irregular, one or more particular ages becoming unduly prominent. But that is a totally different thing from the population-curve which Dr. Hjort presents to us. He tells us that the 1904 group was, and has remained, so predominantly abundant as to constitute for several successive years from one-half to more than three-fourths of the whole stock of adult herrings; not merely that that year-group was more abundant than any one of its immediate successors or predecessors, but that it outnumbered all its contemporaries.

both older and younger, put together; and that this continued year after year, though all the while the great herring fishery was mainly supplied by drafts upon that identical and unfailing brood. That there are fluctuations in the abundance of fish, herring and others, is well enough known; that there are good spawning years and bad, or good and bad years for the survival and growth of the young, is also certain. But an increase of birth-rate or a diminution of natural mortality such as would cause the race of ten-year-old herring to outnumber all the rest put together, from four years old to fifteen, is very hard indeed to imagine.

Here, as it seems to me, is a clear case of a biological problem, based upon statistics, surrounded by mathematical difficulties, where the biologist cannot possibly be sure of his ground until he has enlisted the help of the mathematical statistician.

D'ARCY W. THOMPSON.

The Red Flash.

THE interesting recent letter (NATURE, vol. xciii. p. 664) on the green flash leads me to send a brief note on a much rarer correlative phenomenon, also, of course, due to atmospheric dispersion, viz., the red flash.

Let there be a cloud low down, with a well-defined lower edge, separated from the actual horizon by an interval of clear sky. Then, at the lower edge of the cloud, just as the base of the setting sun reappears, or that of the rising sun disappears, the red flash may be seen.

I have observed the green flash, connected with the top of the sun, scores of times; but the red flash, connected with its base, only about thrice, as the conditions are obviously much less frequently fulfilled.

I venture to think that "flash" is a more suitable term than "ray," for the latter may lead people to suppose that a long streamer of light is to be expected. I last saw the red flash at Clapham (Yorkshire) on September 11, 1913, at 6.30 p.m. It was preceded by a green flash at the upper edge of the cloud.

It may be well to add that, even when all circumstances seem to be apparently favourable, no flash (either green or red) may be visible. My own experience, now a long one, is that failure is decidedly more frequent than success.

C. T. WHITMELL.

Invermay, Hyde Park, Leeds, September 6.

OPENINGS FOR BRITISH CHEMICAL MANUFACTURERS.

AS a result of the state of war between this country and Germany and Austria an unprecedented opportunity has arisen of making a firm endeavour to establish the manufacture of a very large number of chemicals which have hitherto been produced mostly abroad.

It is a mistake to think, as many people do, that most of these are patented articles; on the contrary, the vast majority are very well-known products in considerable demand, and these ought first to receive the attention of the English manufacturer.

It is very desirable, however, and no doubt this course is being largely pursued, that existing manufacturers should endeavour to extend their energies to the production of materials of a similar character to those which they already make, and not to enter an unknown field of manufacture unless they feel very sure of their ground. We have, in this country, the nucleus of a vast chemical industry embracing all, or very nearly all, the ramifications that have been so exhaustively extended by the large German chemical works, and now is the time for that nucleus to expand in a natural way until all our requirements and those of our colonies, our allies, and the neutral States can be fulfilled.

This is a point that requires insistence, as there is considerable danger of manufacturers rushing into the production of materials, hitherto bought from abroad, and only incidentally used in their own business, which in many cases have already been made here, or which, on application to the maker of allied substances, could be produced by him with a minimum expenditure of money and labour. Thus the soap-boiler who has formerly purchased foreign synthetic perfumes, the perfume maker who has bought aniline dyes, the aniline dye manufacturer who has had to depend on Germany for his raw materials, all should apply to existing English manufacturers of their requirements before embarking upon the production of materials foreign to their manufacturing experience. The writer has experienced several cases of manufacturers proposing to prepare chemicals which they imagine have been entirely made in Germany, who have been surprised when informed that such are produced in large quantities in this country.

At the same time, however, there is undoubtedly a great opportunity for starting new manufactures in various directions, but the products to be considered first should be of as simple a nature as possible, especially in the case of organic substances, for the successful manufacture of many of the more complicated of these can only, in most cases, be attained after several years' work.

As regards those articles which are patented or protected by a trade mark the Board of Trade has made rules (Patents, Designs, and Trade Marks (Temporary) Rules, August 21, 1914), under which a German or Austrian patent may be entirely suspended, so that there need be no difficulty in obtaining permission to manufacture according to such patents, and, indeed a large number of applications to this end have already been received at the Patent Office.

Further, it may be stated that, although various organic substances can only be made with the use of ethyl or methyl alcohol, methylated spirits not being suitable, the regulations with regard to these under the Finance Act of 1902 make it possible to use them in manufacture in a convenient manner, and it is for the would-be user to suggest to the Commissioners of Customs and Excise the means by which it is proposed to make the spirits unpotable. This object is obviously easily attained by using either the raw material or the finished product as the "denaturant."

Of the actual chemicals for which there is a demand now owing to the stoppage of imports from the continent, perhaps potassium salts take the first place, as the Stassfurt deposits have, for

a considerable time, been their chief sources. Other sources of potassium salts, however, exist in the nitre found in India and in the kelp of the West Highlands, and it seems feasible to suggest that the latter industry should be taken up again, as it furnishes not only potassium salts but also iodine (compare in this connection W. R. Scott, Report to the Board of Agriculture on the kelp industry in the West Highlands, Blue Book, Cd. 7564).

It must not be forgotten that in many cases sodium salts can be used instead of potassium; thus the bromide, chlorate, dichromate, and permanganate of sodium might be manufactured instead of the potassium salts. In this connection it may be as well to point out that there must be a large amount of potassium salts stored in the various universities and technical schools of this country which might be collected, and, where necessary, worked up for the supply of those salts which are needed now for medicinal purposes in hospitals, etc., until a further supply becomes available. The ordinary employment of potassium salts in the laboratory can easily be avoided by the use of sodium salts in almost every case.

An important industry is that of the manufacture of thorium nitrate, which is used so largely for incandescent mantles. Although this compound is already made in England, the supply is not equal to the demand, and there ought to be little difficulty in diverting the chief source, viz., monazite sand, from Brazil to this country.

The manufacture of the large amount of glass chemical apparatus and other articles, such as cylinders for incandescent lamps, hitherto made from the so-called "Jena-glass"—a borosilicate glass containing zinc and barium oxides—ought certainly to be taken up by English glass makers, and the Potteries should seriously consider the question of supplying Berlin porcelain.

Turning now to the organic side of chemical industry there is a very considerable demand for formic acid and formaldehyde and its derivatives used in medicine, such as hexamethylenetetramine (urotropine), but of all organic medicinal drugs perhaps the greatest shortage is in salicylic acid, which is required also in the preparation of certain dyestuffs. Hitherto the world's supply has been provided by a large German works, and the manufacture of such an important substance in this country is very necessary. Provided with this the production of such drugs as salol (the phenyl ester) and aspirin (the acetyl derivatives) is rendered possible. Other acids, such as benzoic, citric, and tartaric, are also needed.

Of other well-known drugs the manufacture of acetanilide and phenolphthalein is easy, whilst that of phenacetin (acetyl-*p*-phenetidine), atophan (2-quinoline-4-carboxylic acid), antipyrine (phenazone), and its various derivatives, sulphonal and its congeners, veronal, the various guaiacol compounds, and the organic arsenic derivatives, such as atoxyl and salvarsan, is more difficult.

Closely allied to many of the above, from the manufacturing point of view, is the large class of photographic developers, amongst which may be mentioned pyrogallol, hydroquinone, and metol (methyl-*p*-aminophenol sulphate), and synthetic perfumes, such as vanillin, artificial musk, ionone, heliotropine, etc.

Efforts will no doubt be made to produce in England the great quantity of organic dyestuffs hitherto imported from Germany. A considerable number has also been provided by Switzerland, and presumably this importation will continue. A large amount of azo-, nitro-, alizarin, and sulphur dyes has been produced for a long time in England, as well as indulines, magenta, aniline blues, methylene blue, etc., and no doubt the manufacture of these is being largely increased, but there is a great field open to the British manufacturer in the case of vat dyes, such as indanthrene, and its derivatives, of which the raw material is already made here, and synthetic indigo and its derivatives, including thioindigo.

J. C. CAIN.

NOTES.

WE regret to see the announcement of the death, at sixty-six years of age, of Dr. W. H. Gaskell, F.R.S., University lecturer in physiology, Cambridge.

THE *Morning Post* announces that the Huxley Memorial Lecture at Charing Cross Hospital on recent advances in science and their bearing on medicine and surgery, by Sir Ronald Ross, originally fixed for October 1, has been postponed to Monday, November 2.

THE death is announced of Mr. H. M. Freear, chemical assistant at the Woburn Experimental Farm and Pot-culture Station of the Royal Agricultural Society, and a leading authority upon the relation of pot-culture experiments to practical agriculture and horticulture.

MR. EDWARD RILEY, whose death is announced, at eighty-three years of age, was early associated with the production of Bessemer steel at the Dowlais Iron Works in South Wales, where he was chemist from 1853 to 1859. At the May meeting of the Iron and Steel Institute this year, he was awarded the Bessemer gold medal in recognition of his work in analytical chemistry and metallurgy.

AN announcement was made in NATURE of June 18 (p. 415) to the effect that Mr. Thomas Cawthron, of Nelson, New Zealand, had made a gift of 50,000*l.* for a beginning for a solar observatory to be erected in New Zealand. Miss Mary Proctor asks us to state that the amount is "30,000*l.* for a beginning," and that she is responsible for the conflicting statements which have been made, as she was "under the mistaken impression that the amount was 50,000*l.*, and made a statement to that effect without being duly authorised."

THE death is announced, on September 8, at seventy-four years of age, of Mr. William Erasmus Darwin, eldest son of Charles Darwin. It was with reference to this son that Darwin wrote in his autobiography:—"My first child was born on December 27, 1839, and

I at once commenced to make notes on the first dawn of the various expressions which he exhibited, for I felt convinced, even at this early period, that the most complex and fine shades of expression must all have had a gradual and natural origin." These notes provided a natural explanation of phenomena which appeared to be a difficulty in the way of the acceptance of organic evolution, and they formed the basis of the volume, "Expression of the Emotions in Man and Animals," published in 1872.

FROM Göttingen the news is announced of the death of Prof. Wilhelm Lexis, the economist, whose name is well known to students in connection with the "Handwörterbuch der Staatswissenschaften." Lexis was born on July 17, 1837; matriculated at Bonn in 1855, reading there mathematics and natural science. After graduating he was an assistant master at Bonn until 1861, when he went to Paris to study French economic conditions. Very soon he became known as an authority on economic problems, and in 1872 he was appointed to the chair of political economy at Strassburg. Two years later he was called to Dorpat; thence in 1876 he went to Freiburg, where he remained eight years. In 1884 he moved to Breslau, and in 1887 to Göttingen. Here he taught economics for twenty-five years, retiring in 1912 with a reputation that was world-wide.

SINCE the discovery of well-preserved skeletons of ancestral horses in the Eocene formations of North America, palæontologists have been anxious to compare the skulls of these specimens with one from the London Clay of Harwich, which was described by Owen in 1858 under the name of *Pliolophus vulpiceps*. This fossil, in association with various limb-bones of the same animal, was obtained by the Vicar of Harwich at that time, the Rev. Richard Bull, who gave portions of the upper and lower jaws and some fragments of limb-bones to the British Museum, but retained the greater part of the specimen. Since then it has been lost to science, but it now appears that all the associated remains have been carefully preserved by the widow of the discoverer exactly as he left them, and they have just been presented by Mrs. Richard Bull to the Geological Department of the British Museum (Natural History). The skull of Pliolophus, which still remains unique, is thus again accessible for study and comparison. As pointed out by Mr. R. Lydekker, it is probably referable to a species of Hyracotherium.

THE Smithsonian Institution has issued a treatise on atmospheric air and its relation to tuberculosis, by Dr. Guy Hinsdale, one of the prize essays presented in connection with the Washington Tuberculosis Congress (Publication No. 2254, Smithsonian Miscellaneous Collections). The author does not claim that there is any specific climate for tuberculosis. Of first importance are chemically and bacteriologically pure air and sunshine. One thing to be avoided is a climate in which the humidity varies greatly. Probably the best combination is a low humidity and a moderately cool temperature.

THE Local Government Board has issued a supplement containing a third report on infant mortality dealing with infant mortality in Lancashire, by the medical officer of the Board (Dr. Newsholme), and Drs. Copeman, Manby, Farrar, and Lane-Claypon. This county contains nearly one-seventh of the total population of England and Wales, and it suffers from a rate of infant mortality which is equalled in few other parts of the country. The evidence suggests that the most important factors conducing to this are (1) the continuance of unsatisfactory methods of dealing with excremental and domestic refuse; (2) unsatisfactory conditions of housing; (3) the industrial employment of married women during pregnancy and confinement; (4) a relatively low standard of life, especially among the miners.

To the current number of the *Psychological Review* Mr. W. S. Hunter contributes a paper on the after-effects of seen movement, in which several new observations are recorded. He finds that if the original movement be observed by one eye, and if a stationary surface be afterwards viewed by the resting eye, a faint, but distinct, after-movement is noticeable. This after-effect, however, occurs only when the moving field first regarded consists of parallel lines; it does not occur in the case of a rotating spiral. The writer attributes the illusion in the resting eye to eye-muscle strains arising from inhibition of the reflex tendency to follow moving lines; in conformity with which view he finds that in the case of parallel lines the after-effects are reduced or abolished when the eyes adopt a position of strain. He also notes that the illusion can, in part, be successfully controlled by the subject, and hence concludes that in the case of parallel lines the after-movement is determined by "associative factors" and eye-strain, in addition to the retinal changes which, in the case of the rotating spiral, alone play an important part.

IN the Journal of the Gypsy Lore Society (vol. vii., part iii.) the latest theory of the Indian origin of the Gypsies, that of Prof. A. C. Woolner, is discussed. He arrives at the conclusion that the theory of their origin from the Jats is unsupported by philology, and is opposed by the fundamental differences between the characters of the typical Gypsy and the typical Jat. Their connection with the Kafirs of the Hindu Kush is equally improbable. The physique of the modern Dom is very different from that of the present Gypsy, but both types may have been modified by environment and by intermixture with other tribes. Something is to be said for the view of Mr. H. L. Williams (Journal Gypsy Lore Society, vol. v.), who connects them with the Sansiyas and other criminal nomads of Northern India. On the whole, Prof. Woolner's view that the Indian element in Romani is not homogeneous, and that when this type of speech left Indian soil it already contained elements picked up in different parts of that area. In other words, the Gypsies were originally wanderers, and then, as now, picked up in their wanderings unconsidered trifles in the shape of words and grammatical forms. This seems to be a reasonable view, and the evidence appears to point to a migration of the nucleus of the

race from south-east India to the north-west, whence they passed westward from the neighbourhood of Peshawar.

THE seventh annual report of the American Bison Society contains two very satisfactory items—first, that the number of pure-bred bison living in the country at the end of 1913 (inclusive of the 549 calves born the same year) was no fewer than 3788, and, secondly, that the society has decided to include within the scope of its aims the protection of the prongbuck, a species now standing in urgent need of such assistance. It should be added that there is a discrepancy in regard to the number of living bison in different parts of the report, the number given in the president's address being 3453, and that in the summary by the secretary the figure quoted above.

THE imperfections of our seismic records are most noticeable during the periods of great European wars. Accounts of recent earthquakes are, of necessity, rare or brief at the present time; but, in neutral countries, seismological inquiries are being carried on as usual. The weekly bulletins of the Hawaiian volcanic observatory, for instance, record the changes that occur from day to day in its neighbourhood. In the last number (No. 27) Mr. H. O. Wood reports on the earthquakes registered in the Whitney Laboratory of Seismology at Halemaumau from April 21 to July 22, 1914. During these three months sixty-one local shocks were registered, of which only five were perceptible without instrumental aid. The number of shocks is thus at present small for a volcanic centre, but a considerable increase in their frequency will no doubt herald any important outburst.

THE earthquakes of Norway have recently been studied in detail by Mr. C. F. Kolderup (Bergens Museums Aarbok, 1913, pp. 1–152). He gives first a list of the more important earthquakes from 1612 to 1886. After the latter year, the chronicle becomes much more complete. During the twenty-five years 1887–1911, the number recorded is 494, that is, at the rate of nearly twenty a year. In Great Britain the average annual number of earthquakes is twelve; so that, taking area into account, the frequency of earthquakes in the two countries is the same. The Norwegian earthquakes appear, however, to be of greater strength, six having disturbed areas of more than 50,000 square miles, the corresponding number for Great Britain being three. Again, the strongest Norwegian earthquake (that of October 23, 1904) disturbed an area of 367,000 square miles; while the strongest British earthquake (that of December 17, 1896) disturbed 98,000 square miles. In both countries the earthquakes are most frequent during the winter months; and, throughout the day, are most perceptible during the hours 10–11 p.m. and 1–2 a.m.

THE limited literature on iridium in its mineral forms is enriched by Bulletin 17 of the Geological Survey of Tasmania (John Vail, Hobart, 1914), by W. H. Twelvetrees, on "The Bald Hill Osmiridium Field." The mineral occurs here as granules, with magnetite, chromite, nickeliferous pyrrhotine, and gold, in an altered peridotite, and is mostly won from alluvium. From the interesting review of the occurrence and use of iridium in the world at large, we gather that a certain mystery overhangs the trade, since the tipping of nibs for fountain-pens, and the production of hard ends for other apparatus, scarcely account for the increased demand for osmiridium.

RECENT publications of the Geological Survey of the Department of Mines, Tasmania, are concerned with interesting mining areas. Bulletin 14, on "The Middlesex and Mount Claude Mining Field," and 15, on "The Stanley River Tin Field," describe the tin ores that were introduced into metamorphosed pre-Cambrian sediments by the uprise of granite in Devonian times. L. L. Waterhouse concludes that the banded ore-deposits of the Stanley River represent an actual replacement of the original country-rock, the structures of which are often preserved, even in the sulphide-ores. Bulletin 16, on "The Jukes-Darwin Mining Field," contains views of the forest-clad foothills and the great ridges of schist and granite east of Macquarie Harbour. The topography has been notably modified by glacial action.

THE Australian Geological Surveys materially assist in the development of the resources of the country. Since the work that was noticed in NATURE, vol. xciii., p. 307 (May 21, 1914), we have received several publications dealing with mineral deposits. E. C. Saint-Smith and R. A. Farquharson describe the Southern Cross area of the Yilgarn Goldfields (Geol. Surv. W. Australia, Bull. 49), where quartz-reefs occur in a complex country, which includes banded jaspers that may be of sedimentary origin. The most important reefs from an economic point of view occur as metasomatic replacements of schists along shear-zones, while those in the granite from which the siliceous infiltrations spread bear very little gold. The northern part of Kalgoorlie is described in Bulletin 51, and here the ferruginous jaspers, which have so wide an interest among the old rocks of both hemispheres, become in part graphitic as they approach deposits of sulphide ores.

IT has been established by persistent statistical researches that the south-west monsoon rainfall in India is affected by various previous conditions in or outside that area, and seasonal forecasts based thereon have been made with more or less success since 1882. In a recent paper, entitled "A Further Study of Relationships with Indian Monsoon Rainfall" (Memoirs, vol. xxi., part viii.), Dr. Walker discusses at considerable length several correlations from all available data, but the results of this useful investigation have mostly proved to be of a negative character. (*a*) *Relationship with previous barometric pressure in India*: There is a tendency for the pressure of any year to be high when the monsoon is deficient, and *vice versâ*, but the indications do not seem to be of much practical use in forecasting the character of the monsoon a few months before its arrival. (*b*) *Relation with previous Indian temperature*: It is generally admitted that the monsoon rainfall is connected with the replacement of heated air by damper air from the ocean, and that years of high temperature in May should be years of good rainfall, but it is shown that this is not the case. Dr. Walker thinks that improved know-

ledge of conditions in the upper air will eventually throw light upon the matter. (*c*) *Effect of icebergs in the Southern Ocean*: From an examination of the Meteorological Office tables of icebergs published in the Monthly Meteorological Charts of the Indian Ocean, separately tabulated for each ocean, by Dr. Shaw's direction, it does not appear that the icebergs of the Indian Ocean have any material effect. The data for the South Atlantic appear to be more promising, but no definite conclusion can yet be formed.

THE Indian Association for the Cultivation of Science has republished, as Bulletin No. 10, under the title, "Optical Theories: a Brief Historical Survey," the address delivered by Prof. Mallik at the annual meeting in November last. In sixteen pages the author sketches the development of scientific ideas as to the nature of light from those of the early Greek philosophers to the modern view, according to which it is an electromagnetic phenomenon taking place in an æther through which are distributed singularities of a simple kind known as electrons and of a complex kind known as matter. He shows that at the time the Greeks were discussing the rival theories of Pythagoras, that light consisted of particles projected from luminous bodies to the eye, and of Empedocles, who held that for vision a so-called "visual influence" was necessary in addition, the Indian philosophers were discussing the problem on almost identical lines.

IN Mr. F. W. Lanchester's second article in *Engineering* for September 11, on aircraft in warfare, it is stated that the weaknesses of the dirigible on the defensive are so great and of such a character as to render it quite unfit to remain an active participant in aerial warfare. It may escape for a time, and may render a certain amount of useful service, but only thanks to the circumstance that the number of high-powered, fast-climbing aeroplanes is comparatively limited, and to the fact that scientific methods of attack have not yet been fully worked out or put into practice. However, even to-day the finest of Germany's fleet of Zeppelins would be absolutely at the mercy of a modern aeroplane in the hands of a man prepared to make his one and last sacrifice. So fragile and combustible a contrivance as a dirigible, whether rigid or non-rigid, can never, in Mr. Lanchester's opinion, survive in the face of the rapid development of the modern aeroplane and the engines of offence with which before long it will be furnished.

SOME interesting notes on the relation of rainfall and yield are contributed by Mr. D. Halton Thomson to *Engineering* for September 4. If the annual yield for a given drainage area be plotted against the rainfall for the corresponding period, the points generally are distributed in a haphazard manner, and there is difficulty in drawing a simple curve—usually assumed to be a straight line. The irregularities may be due to inaccurate observations, the varying physical conditions of the drainage area from year to year, and to the fact that the yield lags behind the rainfall. If twenty or more consecutive annual observations are available, the author suggests that the two phenomena may be correlated on the assumption that the rainfall of a given frequency produces a yield of the same frequency. Time-lag and difference of time-distribution may be eliminated by this means. The author derives a formula on this assumption for the Redmires drainage area of the Sheffield Waterworks, and finds $Y=R-14$, Y being the annual yield and R the annual rainfall, both in inches. The formula for the Trenchford drainage area of the Torquay Waterworks is $Y=0{\cdot}9R-13$. In the first case the annual evaporation is 14 in., whatever the rainfall, and in the second case the annual evaporation increases slightly with the rainfall.

THE *Engineer* for September 4 has an article dealing with the problem of pitwood supplies, the dearth of which, brought about by the war, is becoming a matter for serious consideration by colliery companies. Northern Russia, whence important cargoes have been usually shipped, is no longer able to keep up the supply, and scarcity of labour in south-west France has resulted in the suspension of cutting and transporting; shipments from Norway and Sweden are at present impracticable. It seems that only one alternative is to be found if the dearth of pitwood becomes extreme. To most collieries the permanent use of steel would be too expensive. It has been suggested that scrap tubes and rails, cut to suitable lengths, would make good substitutes for pit timber. A midland colliery has used for some time props made from old steel pipes; these are filled with soft and hard wood, the pipes forming a strengthener to the wood portion. This composite prop is lighter and stronger than the ordinary wood prop, is adjustable in length, and by its soft ends gives good warning of a collapse. Our contemporary suggests that the filling in of worked out parts of mines with sand, ash, slag, etc., would lead, among other important advantages, to a diminished demand for timber for pit purposes.

OUR ASTRONOMICAL COLUMN.

COMET 1913*f* (DELAVAN).—Delavan's comet is gradually moving westward among the stars; while it is now best observed in the early morning, it will, towards the end of the month, be an evening object for observation as well. The ephemeris given in this column last week is quite sufficient for anyone to detect this naked-eye object. Those possessing clock-driven equatorials can do useful work by strapping small cameras on to the telescope tube for the photography of the tail. During the evening of September 14 the comet was seen to have brightened very considerably, and was a conspicuous object to the naked eye. It was situated towards the west of θ Ursæ Majoris (3·2 mag.), but a more correct position would be to the west of 31 Ursæ Majoris, and close to this star. In fact, 31 Ursæ Majoris was involved in the tail. The nucleus closely approximated in brightness to ν Ursæ Majoris, a fourth magnitude star.

FURTHER NEWS OF ECLIPSE PARTIES.—The current number of the *Observatory* (September) publishes several items of interest about the parties which went out for the eclipse. It is stated that no news has come to hand about the Cambridge Solar Physics Observatory party, but that Mr. Stratton had been previously recalled for military service, and arrived in England on August 23. Major Hills and Prof. Fowler

describe briefly the attempt to reach their observing station at Kiev (Russia); they only got so far as Riga, and had to return. According to the *Morning Post* (September 7) the Russian astronomers were disappointed at the fact that Major Hills and Prof. Fowler when at Riga did not communicate with Prof. Backlund, because a Russian eclipse expedition went to Riga prepared to assist them in every way. As it happened, the weather at Riga was much finer than at most of the eclipse stations. The *Morning Post* gives further information about the German astronomers, who were invited to Russia to observe the eclipse. It seems that the German parties were warned in time to return, and some did so. Those who hesitated were arrested and sent to Odessa. It is then stated, "The American party packed up the German instruments and sent them also to Odessa, but nothing has been heard of them since, and the German astronomers have been vainly appealing to Prof. Backlund, who is naturally helpless and cannot interfere personally."

VERTICAL CIRCLE OBSERVATIONS AT THE U.S. NAVAL OBSERVATORY.—Vol. viii. (second series) of the Publication of the United States Naval Observatory contains the vertical circle observations made with the 5-in altazimuth instrument for the period 1898 to 1907. The observations were made by Messrs. F. B. Littell, G. A. Hill, and H. B. Evans, and were reduced by the first-named. The volume is subdivided into introduction, observations and reductions, individual results of observations and catalogue. The introduction contains an account of the instrument, which was built by Messrs. Warner and Swasey, under the supervision of Prof. William Harkness; it was completed and housed at the end of 1897, and first used in February, 1898. The aperture of the telescope is 5·02 in., and the focal length is 50 in. Two sections and a photograph of the instrument *in situ* illustrate the general arrangements. Pp. 1–389 show the observations and reductions; pp. 393–445 are devoted to the individual results of the observations; and pp. 447–65 give the catalogue. In the last-mentioned the magnitudes are those of the Revised Harvard Catalogue. The declinations are derived from the means of the individual results by the application of the corrections for flexure and latitude; they are for the epoch given in the column headed "Mean Date," and for the mean equator 1900·0. The precessions and secular variations are based on Newcomb's constants.

PARALLAXES OF THE BRIGHTER GALACTIC HELIUM STARS.—No. 82 of the Contributions from the Mount Wilson Solar Observatory, reprinted from the *Astrophysical Journal*, vol. xl., 1914, July, contains an extensive and important research by Prof. J. C. Kapteyn, entitled "On the individual parallaxes of the brighter galactic helium stars in the southern hemisphere together with considerations of the parallax of stars in general." The communication covers eighty-six pages, and is divided into twenty sections, the first being composed of an introduction and a summary. The stars chosen are the helium stars brighter than the 6th magnitude for the part of the sky lying between galactic latitudes ±30°, and galactic longitudes 216°–360°. In a subsequent paper or papers, he hopes to deal with the helium stars in the other parts of the sky. For the brighter stars of other spectral classes he has not attempted to derive individual parallaxes, but has discussed the prospects of the successful treatment of such an investigation. The reader must be referred to the paper itself for the details and results of the investigation, but attention may be directed here to the very interesting charts dealing with the distribution of the helium stars as regards galactic positions illustrating the apparent tendency of these stars to clustering. The most extensive of these clusters is between longitudes 200° and 340°, and this group forms the main subject of the present paper. Another chart gives the arrangement of the helium stars in space. Prof. Kapteyn directs particular attention to three fairly strong condensations with different parallaxes, and he says: "Of course, we may see in the arrangement of these condensations the indication of a spiral structure. I shall not lay much stress on this, unless we find the same thing repeated in other parts of the sky."

PAPERS ON INVERTEBRATES.

THE anatomy of the blind prawn of the Sea of Galilee (Lake of Tiberias), described by Dr. Calman in 1909 as the representative of a peculiar genus, under the name of *Typhlocaris galilea*, is discussed by Mr. Ghosh in vol. ix., No. 6, of the Journal and Proceedings of the Asiatic Society of Bengal. In another article in the same issue Messrs. Annandale and Kemp point out that, so far as known, the Sea of Galilee is the home of only three species of decapod crustaceans, of which the aforesaid Typhlocaris is noticeable on account of its marked structural differences from all other members of the group, as well as for its apparent modification for subterranean existence. As a matter of fact, it is known from a single open and well-lighted pool near the marge of the lake, and the authors suggest that earth-movements may have been the cause of this departure from its apparently proper habitat.

In the April number of the Records of the Indian Museum, Mr. Kemp continues his notes on the decapod crustaceans in the Indian Museum, dealing in this instance with the family Hippolytidæ, a group notable on account of the great generic variation in bodily form and in secondary sexual characters. Several species and two genera are described as new.

New and other African scorpions, spiders, etc., form the subject of an article by Mr. J. Hewitt in vol. iii., part 1, of Records of the Albany Museum. It is noteworthy that a two-lunged spider, *Cydrela friedlanderi*, of the family Zodariidæ, resembles the members of a totally different group in closing the entrance to its burrow by means of a trap-door. In the two-lunged trap-door species the females are bright-coloured like their allies, which do not protect themselves in the same manner; in other trap-door spiders, on the contrary, the females lack bright colours.

Two infusorians of the family Cothurnidæ found in moss during Dr. Charcot's Antarctic expedition led Mr. E. Penard to undertake a re-investigation of moss-dwelling rhizopods and infusorians, the first result of which is an elaborate article on the Cothurnidæ communicated by that naturalist to the *Mém. Soc. Phys. et Hist. Nat. Genève* (vol. xxxviii., fasc. 1). These organisms form an important feature of the invertebrate life of the polar regions, where moss and lichens constitute the chief vegetation; they are, however, by no means restricted to high latitudes, and the author has devoted much attention to the question whether in warmer zones they may not pass part of their time in open water. His answer is that while some are exclusively moss-dwellers, others appear to spend weeks, if not months, periodically in water.

Among the contents of the first *livraison* of vol. xlv. of *Trav. Soc. Imp. Nat., St. Pétersbourg.*, is an article on the anatomy and physiology of the synaptid holothurians, to which a brief abstract in French is appended.

We have been favoured with copies of three papers contributed by Mr. E. W. Adair to the *Bull. Soc. Entom. d'Egypte* for 1912 and 1913, published 1914. In the first (1912) of two relating to the life-histories of the insects of the family Mantidæ it is pointed out that the supposed additional metamorphic stage recorded by Pagenstecher in the case of *Mantis religiosa* was due to the newly emancipated imago being enveloped in the amnion of the ovum. In the third paper the author records "jumping seeds" of *Tamarix nilotica*, the movements of which were produced by imprisoned larvæ of a small weevil, *Nanophyes maculatus*. Hitherto similar movements have been known only in the case of the Mexican so-called "jumping beans," of which the moving power are the larvæ of certain tortricid moths, especially *Carposapsa saltitans*.

In an article contributed to vol. iv. (new series), part i., of the Transactions of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, Mr. R. S. Bagnall states that whereas a few years ago only a single representative of the centipedes of the group Symphyla was known from the British Isles, he had been enabled to raise the number to no fewer than twelve species and one subspecies, five of the former, of which three are described as new, belonging to the genus Scutigerella, and the remaining seven, of which six are new, together with the subspecies (also new) to Scolopendra. In a supplemental article published near the end of the same issue he describes a seventh new species of Scolopendra, from Cheshire, and raises the aforesaid subspecies to specific rank, thus recording a total of fourteen British species, of which, however, one Scutigerella has hitherto been detected only in hothouses.

In No. 1 of vol. v. of the Entomological Series of the Memoirs of the Department of Agriculture, Mr. C. C. Ghosh continues his life-histories of Indian insects, dealing in this instance with eleven species of butterflies, inclusive of the common British cabbage-white. The account of the rice-leaf caterpillar, and its butterfly, so injurious to rice-crops all over the Old World and Australia, is from MS. left by Mr. Maxwell-Lefroy, when Government entomologist. The nine coloured plates are admirably executed.

Fuller acquaintance with the insect-fauna of the eastern and north-eastern districts of the Transvaal and southern Rhodesia has enabled Dr. L. Péringuey to add considerably to the list of South African representatives of the hymenopterous family Mutillidæ. His first article on the subject was contributed to vol. i. of the *Annals of the S. African Museum* (1898): his latest forms part 15 of vol. x. of the same serial (1914).

Beetles of various families, inclusive of the Tenebrionidæ, Cetoniidæ, and Buprestidæ, collected during the Duke of Mecklenburg's travels, form the subject of articles by various specialists in Lief. 3 of the first volume of the Zoological section of *Ergebnisse der Zweiten-Deutschen Zentral-Afrika-Expedition*, 1910–1911. Many new species are named, and it may be well to note that the name of the Ubangi Valley has been adopted as a generic designation, "Ubangia."

An extensive collection of brittle-stars, or ophiurids, from the Caribbean Sea in the U.S. National Museum has enabled Prof. René Koeler not only to describe a number of new species, but, what is more important, to rectify the definition of previously known species and groups. His monograph, illustrated by eighteen beautifully executed plates in black and white, forms Bulletin No. 84 (173 4to pp.) of the U.S. National Museum. R. L.

OFFICIAL FISHERY PUBLICATIONS.[1]

IN its annual report for the year 1912, the fisheries branch of the Board of Agriculture and Fisheries made a marked change in the manner of reporting the results of their administration, and we are glad to note that this change is still more apparent in the report for last year. For the first time we are now presented with an account of the progress of the English sea fisheries, which is characterised by close insight into the conditions of the industry, and by a very attentive study of those tendencies that are making for the modification, in many ways, of the fisheries of England and Wales.

Part i. of the report is a document of great interest even to the ordinary reader interested in public affairs. It deals clearly and concisely with the industry in general, emphasising various matters of special importance arising during 1913. The remarkable herring fishery of the last two years; the great development, during this time, of the fishery for herring by means of the trawl net; the utilisation of by-products; the development of the internal combustion engine as a means of propulsion of fishing vessels; the application of wireless telegraphy in the deep-sea fisheries; the economics of the French sardine industry; the rapid development of scientific research by the Board: these and other matters, together with a good review of the year's fisheries and the administrative work of the Board, make up this interesting volume. Part ii. is a document for the specialist. It consists of statistical tables and synoptic charts, and those concerned with fisheries inquiries will welcome the increasing amount of detail exhibited in this representation of the year's fisheries. Still greater detail in relation to the less important fisheries is desirable, but it is apparent that, for this purpose, a much greater development of local administration by the Board may be necessary.

These reports are a contribution, though in a greatly modified and much more valuable form, of the former fisheries reports of the department. The third paper before us begins a new series of publications containing the results of scientific researches carried out by the officers of the Board. It is a statistical account of the English haddock fishery in the North Sea. The species is one which is most abundant in the northern parts of the North Sea, less abundant to the west of Great Britain, and practically absent, or capricious in its distribution and abundance, in the Irish Sea and the English Channel. Commercial statistics are utilised by Mr. Russell to give a picture of the distribution of the fish, and of its seasonal abundance, and the variations of abundance from year to year. These statistical summaries are most valuable; they indicate irresistibly those periodic fluctuations which are plainly to be correlated with periodic physical changes in the sea, or even with periodic cosmic changes. Measurements of length, of samples of fish taken at the great ports, are also summarised by Mr. Russell, and are so treated as to supplement the commercial statistics. In this way more than two and a half millions of fish have been dealt with. Biological observations have also been made, but a discussion of these is reserved for a future report.

Numerous determinations of average weight of the fishes landed are also summarised, with the object of throwing light on the variations in nutrition according to age and season. The author shows that the well-known length-weight formula now used in fishery

[1] Board of Agriculture and Fisheries. Annual Report on the Sea Fisheries for the Year 1913. Part i., Report; Part ii., Tables and Charts. [Cd. 7448-9] (1914.)

Fishery Investigations. Series ii., vol. i., part i., Report on Market Measurements in Relation to the English Haddock Fishery during the Years 1909-11. By E. S. Russell. (1914.)

investigations does not apply to his series. According to this formula, the weight of a fish at different ages is a function of the cube of the length. A mathematical investigation of Mr. Russell's average weights by Pearson's "method of moments" shows, however, that the weight of a fish at different ages is to be represented only by a series of the form,

$$a+bl+cl^2+dl^3+\ \ldots,$$

l being the length of the fishes. It is possible that these terms have each a physical meaning; the fish grows irregularly as its age advances, so that its weight is a function of length, surface, volume, and density, all of which dimensions vary in relation to each other in different phases of the individual life-history. J. J.

WATER SUPPLY.[1]

ONE of the difficulties besetting the agriculturist in the vast area known as the Great Plains and constituting the central region of the United States is the irregular rainfall. The land is fertile enough, but a recurring series of dry years militates greatly against its effective development. Attempts have been made to remedy the evil by means of artificial irrigation, but so far these efforts have been sporadic and local, and, consequently, they have not produced the completely beneficial results which might be obtained if all the ground water were systematically conserved and utilised.

The United States Government hydrological service, as the result of their investigations, are publishing from time to time a series of water supply papers specially devoted to a consideration of this problem as affecting various localities, and four reports before us (Nos. 345 A, B, C, and D), issued this year, deal with districts in Oklahoma, Kansas, and New Mexico. They are useful little pamphlets, affording much detailed information on the geological formation and available water resources of the respective areas. Not the least useful feature, perhaps, is a discussion on the depth and cost of wells, and on the power required for pumping. There is a much-needed caution to prospective irrigators to consider carefully the whole of the outlay likely to be involved in any system of artificial irrigation before embarking upon it, lest it should prove to be financially unremunerative and unsound.

Water Supply Paper, No. 340 A (Washington: Government Printing Office, 1914), of the United States Geological Survey, contains a list of the stream-gauging stations situated in the North Atlantic coast drainage basins, and a summary of the reports and publications relating to water resources within this area (1885–1913). It forms a convenient bibliographical index, and should prove most useful for reference purposes to anyone desirous of consulting the literature on the subject.

Three annual reports on the discharge of rivers in the United States are comprised in Water Supply Papers, Nos. 309, 322, and 324 (Washington: Government Printing Office). The first deals with the Colorado River Basin for the year 1911; the other two are for the year 1912, and cover the St. Lawrence River Basin and the basins of the South Atlantic coast and eastern Gulf of Mexico respectively. The numerous observations made have been carefully compiled and tabulated, and, in conjunction with those previously published, form a very useful scientific record of stream flow and discharge in the areas specified. Each pamphlet has an introductory note on the methods employed in gauging, and, in the 1912 reports, there are some interesting photographs and diagrams.

[1] Paper 345 *a*: Preliminary Report on Ground Water for Irrigation in in the vicinity of Wichita, Kansas. Paper 345 *b*: Ground Water for Irrigation in the vicinity of Enid, Oklahoma. Paper 345 *c*: Underground Water of Luna County, New Mexico. Paper 345 *d*: Ground Water for Irrigation in the valley of North Fork of Canadian River, near Oklahoma City, Oklahoma, Washington, 1914. Government Printing Office.

THE AUSTRALIAN MEETING OF THE BRITISH ASSOCIATION.

SECTION H.

ANTHROPOLOGY.

OPENING ADDRESS BY SIR EVERARD IM THURN, C.B., K.C.M.G., PRESIDENT OF THE SECTION.

A Study of Primitive Character.

CIVILISATION and "savagery"—for unfortunately it seems now too late to substitute any term of less misleading suggestion for that word "savagery"—are the labels which we civilised folk apply respectively to two forms of human culture apparently so unlike that it is hard to conceive that they had a common origin—our own culture and that other, the most primitive form of human culture, from which, at some unknown and distant period, our own diverged. But, assuming one common origin for the whole human race, we anthropologists can but assume that at an early stage in the history of that race some new idea was implanted in a part of these folk, that is, in the ancestors of civilised folk, which caused these thenceforth to advance continuously, doubtless by many again subsequently diverging and often intercrossing roads, some doubtless more rapidly than others, but all mainly towards that which is called civilisation, while those others, those whom we call "savages," were left behind at that first parting of the ways, to stumble blindly, advancing indeed after a fashion of their own, but comparatively slowly and in a quite different direction.

It is easy enough for civilised folk, when after age-long separation they again come across the "savages," to discern the existence of wide differences between the two, in physical and mental characteristics, and in arts and crafts; it is not so easy, it may even be that it is impossible, to detect the exact nature of these differences, especially in the matter of mental characters.

As a rule the occupant of this presidential chair is one who, whether he has seen much of "savages" at close quarters or not, has had much ampler opportunity than has fallen to my lot of comparative study of that great mass of anthropological observations which, gathered from almost every part of the world, has now been recorded at headquarters. I, on the other hand, happen to have spent the better part of my active life in two different parts of the world, remote from books and men of science, but in both of which folk of civilised and of savage culture have been more or less intermixed, but as yet very imperfectly combined, and in both of which I have been brought into rather unusually close and sympathetic contact with folk who, whatever veneer of civilisation may have been put upon them, are in the thoughts which lie at the back of their minds and in character still almost as when their ancestors were at the stage of savage culture.

While trying to adjust the mutual relations of wild folk and of folk of civilised stock, I have seen from close at hand the clash which is inevitable when the two meet—a clash which is naturally all the greater when the meeting is sudden. Moreover, having started with a strong taste for natural history, and

especially for the natural history of man, and having had much guidance from many anthropological friends and from books, I have perhaps been especially fortunate in opportunity for studying the more natural human animal at close quarters and in his natural surroundings. I have tried, from as abstract and unprejudiced a point of view as possible, to understand the character, the mental and moral attitude, of the natural "savage" as he must have been when civilised folk first found him and, at first without much effort to understand him, tried abruptly to impose an extremely different and alien form of culture on this almost new kind of man.

I venture to claim, though with diffidence, that I may have begun to discern more clearly, even though only a little more clearly than usual, what the primitive man, the natural "savage"—or, as he might more accurately be described, the wild man—was like; and it seemed possible that an attempt to bring together a picture—it can hardly be more than a sketch—of the mentality and character of some one group of people who had never passed out of the stage of "savagery" might be interesting and practically useful, especially if it proves possible to disentangle the more primitive ideas of such people from those which they subsequently absorbed by contact, at first with other wild, but less wild, folk, and later with civilised folk; and that a further study of the retention by these folk of some of their earlier habits of thought during later stages in their mental development might suggest a probable explanation of certain of their manners and customs for which it is otherwise hard to account.

The attainment of some such understanding is, or should be, one of the chief objectives of the practical anthropologist, not merely for academic purposes, but also for the practical guidance of those who in so many parts of our Empire are brought into daily contact with so-called "savages."

Perhaps hardly anywhere else in the world would it be possible to find better opportunity and more suitable conditions for such a study as I now propose than in the tropical islands of the South Seas. The ancestors of these islanders, while still in purely "savage" condition, must have drifted away from the rest of the human race, and entered into the utter seclusion of that largest of oceans, the Pacific, covering as it does more than a third of the surface of the globe, long before the first man of civilised race, Balboa, in 1513, from the Peak in Darien, set eyes on the edge of what he called "the Great South Sea," before Magellan, in 1520, forced his way into and across the same sea, which he called the Pacific, and certainly long before civilised men settled on any part of the shore of that ocean, *i.e.*, in 1788, at the foundation of Australia. For when first studied at close quarters by civilised folk from Europe, which was not until after the last-named event, these South Sea "savages" had been in seclusion during a period sufficiently long—and certainly no short period would have sufficed for such an effect—not only for them all to have assumed characters, cultural and even physical, sufficient to distinguish them from all other folk outside the Pacific, but also for them to have split up into many separate parties, probably sometimes of but few individuals, many of which had drifted to some isolated island or island-group, and had there in the course of time taken on further well-marked secondary differences.

It will probably now never be discovered when, how often, and from what different places the ancestors of these folk reached the Pacific. It is quite possible that they entered again and again, and were carried by winds and currents, some from west to east and some in the reverse direction, many perishing in that waste of waters, but some reaching land and finding shelter on some of that great cloud of small islands which lie scattered on both sides of the equator and nearly across that otherwise landless ocean.

Of the folk who in those old times thus drifted about and across the Pacific, the most important, for the part which they played in the story which I am endeavouring to tell, were the two hordes of "savages" now known respectively as Melanesians and Polynesians. Without entering deeply into the difficult subject of the earlier migrations of these two hordes, it will suffice here to note that, towards the end of the eighteenth century, when European folk at last began to frequent the South Sea Islands, and when consequently something definite began to be known in Europe about the islanders, certain Melanesians, who had probably long previously drifted down from north-westward, were found to be, and probably had long been, in occupation of the exceptionally remote and isolated Fiji Islands; also that, long after this Melanesian occupation of these islands, and only shortly before Europeans began to frequent them, several bodies of Polynesians, who had long been in occupation of the Friendly or Tongan islands, lying away to the east of Fiji, had already forced or were forcing their way into the Fijian islands.

The meeting in Fiji of these two folk, both still in a state of "savagery," but the Polynesians much further advanced in culture than the Melanesians, at a time before European influence had begun to strengthen in those islands, affords an exceptionally good opportunity for the study of successive stages in the development of primitive character, especially as the two sets of "savages" were not yet so closely intermingled as to be indistinguishable—at least in many parts of Fiji. It is unfortunate that the earlier European visitors to Fiji were not of the kind to observe and to leave proper records of their observations.

The earlier, Melanesian, occupants of Fiji had to some extent given way, but by no means readily and completely, to the Polynesian invaders. The former, not only in the mountain fastnesses difficult of access, but also in such of the islets as the local wind and weather conditions made difficult of access, retained their own distinct and simpler culture, their own thoughts, habits, and arts, long after the Polynesians had seized the more important places accessible to the sea, and had imposed much of their own more elaborate (but still "savage") culture on such of the Melanesian communities as they had there subjugated and absorbed.

The social organisation throughout Fiji remained communistic; but in the purely Melanesian communities the system was purely democratic (*i.e.*, without chiefs), while in the newer mixed Polynesian-Melanesian communities—as was natural when there had been intermingling of two unequally cultured races—there had been developed a sort of oligarchic system, in which the Melanesian commoners worked contentedly, or at least with characteristic resignation, for their new Polynesian chiefs.

Alike in all these communities custom enforced by club-law prevailed; but in the one case the administrative function rested with the community as a whole, while in the other it was usurped by the chiefs.

Though we are here to consider mainly the ideas, the mentality, of these people, it will be useful to say a few preliminary words as to their arts and crafts. The Melanesians during their long undisturbed occupation of the islands had undoubtedly made great progress, on lines peculiar to them, especially in boat

building, in which they excelled all other South Sea islanders, in the making of clubs and other weapons, and in otherwise using the timber, which grew more abundantly, and of better quality, in their islands than elsewhere. Meanwhile the Polynesians, in their earlier homes and long before they reached Fiji, had developed, in very high degree, corresponding but different and much more elaborate arts (and ideas) of their own. But, as we know from Captain Cook, the Polynesians, despite their own higher culture, from their Tongan homes, greatly admired and appreciated the special craftsmanship of the Fijians, and it was indeed this admiration which attracted the former from Tonga to Fiji; and when the Polynesians had gained footing in the Fijis they—quite in accordance with human nature—were inclined, for a time at least, to foster the foreign Fijian arts—if not Fijian ideas—rather than replace these by their own arts; and before the struggle, both physical and cultural, between the two sets of "savages" had gone far it was interrupted, and more or less definitely arrested, by the arrival and gradual settlement of the still more powerful, because civilised, white folk from the Western world.

In turning to the earlier (Melanesian) occupants of Fiji, and especially to the less advanced of these, to find the traces of which we are in search of the more primitive habit of thought, it must not be forgotten that even at the stage at which we begin to know about them they had made considerable advance, in their ideas as well as in their arts and crafts. They still used their most primitive form of club, but also made others of much more elaborated form; so, though the ideas which lay at the basis of their habit of thought were of very primitive kind, they had acquired others of more complex character.

Before going further may I say—and I sincerely hope that suggestion will not be misunderstood—that in the difficult task of forming a clear conception of the fundamental stock of thought which must have guided the conduct of the more primitive folk we must constantly bear in mind the parallelism (I do not mean necessary identity of origin) between the thoughts of the earliest human folk and the corresponding instincts (as these are called) noticeable in the case of some of the higher animals? I am particularly anxious not to be misunderstood; the suggestion is not that even the most primitive human folk were mentally merely on a par even with the higher animals, but that many, perhaps most, of the ways of thought that guided the primitive man in his bearing towards the world outside himself may be more easily understood if it is once realised, and afterwards remembered, that the two mental habits, however different in origin and in degree of development, were remarkably analogous in kind.

A similar analogy, in respect not of thoughts but of arts, may well illustrate this correspondence between the elementary ideas of men and animals. The higher apes occasionally arm themselves by tearing a young tree up by the roots and using the "club" thus provided as a weapon of offence and defence against their enemies. Some of the primitive South Sea islanders did—nay, do—exactly the same, or at any rate did so until very lately. The club—the so-called *malumu*—which the Fijian, then and up to the much later time when he ceased to use a club at all, greatly preferred to use for all serious fighting purposes was provided in exactly the same way, *i.e.*, by dragging a young tree from the ground, and smoothing off the more rugged roots to form what the American might call the business end of the club. But though the Fijian, throughout the period during which he retained his own ways, used and even preferred this earliest form of club, he meanwhile employed his leisure (which was abundant), his fancy, and his ingenuity, in ornamenting this weapon, and also in gradually adapting it to more and more special purposes, some of the later of which were not even warlike but were ceremonial purposes, until in course of time each isolated island or group of islands evolved clubs special to it in form, purpose, and ornament, and the very numerous and puzzlingly varied series of elaborate and beautiful clubs and club-shaped implements resulted. It seems to be in power of improvement and elaboration that lies the difference between men-folk and animal-folk.

Something similar may be assumed to have brought about the evolution of the ideas of these islanders. Starting with a stock of thoughts similar in kind to the instincts of the more advanced animals, the human-folk—by virtue of some mysterious potentiality—gradually adapted these to meet the special circumstances of their own surroundings, and in so doing ornamenting these primitive thoughts further in accordance with fancy.

In the Fiji islands this process of cultural development was probably slow during the long period while the Melanesians, with perhaps the occasional stimulus afforded by the drifting in of a little human flotsam and jetsam from other still more primitive folk, were in sole occupation; yet it must have been during this period and by these folk that the distinctly Fijian form of culture was evolved. But the process must have been greatly accelerated, and at the same time more or less changed in direction, by the incoming of the distinct and higher Polynesian culture, at a time certainly before, but perhaps not very long before, the encroachment of Europeans.

In order to realise as vividly as possible what were the earlier, most elementary, thoughts on which the whole detail of his subsequent "savage" mentality was gradually imposed, it is essential for the time being to discard practically all the ideas which, since the road to civilisation parted from that on which savagery was left to linger, have built up the mentality of civilised folk; it is essential to try to see as the most primitive Fijian saw and to conceive what these islanders thought as to themselves and as to the world in which they found themselves.

It seems safe to assume that the primitive man, absolutely self-centred, had hardly begun to puzzle out any explanation even of his own nature, still less of the real nature of all the other things of which he must have been vaguely conscious in the world outside himself. To put it bluntly, he took things very much as they came, and had scarcely begun to ask questions.

He was—he could not but be, as the lower animals are—in some vague way conscious of himself, and from that one entirely self-centred position he could not but perceive from time to time that other beings, more or less like himself, were about him, and came more or less in contact with him.

The place in which he was conscious of being appeared to him limitless. He did not realise that he could move about only in the islet which was his home, or perhaps even only in a part of a somewhat larger, but according to our ideas still small, island; if other islets were in sight from that on which he lived, these also would be part of his world, especially if—though such incidents must have been rare—he had crossed to, or been visited by strangers from, those islands—islands which lay between his own home and that which he spoke of as *wai-langi-lala* (water-sky-emptiness) and we speak of as the horizon. To him the world was not limited by any line, even the furthest which his sight disclosed to

him. Rarely, but still sometimes, strangers had come from beyond that line. Perhaps, too, he had some time heard that his ancestors had come from the somewhere which seemed beyond. Again, his ancestors of whom he had heard, and even some of the contemporaries whom he had seen, though no longer with him, except occasionally during his dreams, in bodily form, were somewhere, somewhere beyond that line of sight. Even he himself (in what were his dreams, as we say, but to him were part of his real life) habitually went beyond the line, and, so far as his experience had gone, returned each time to the island home.

Moreover, he did not doubt that this limitless region in which it vaguely seemed to him that he, and innumerable other beings, moved, extended not merely along what we speak of as the surface of the globe, but also, and equally, without any intervening obstacle, up into the infinite space above and beyond the sky. In short, to this primitive man the world, though the part of it to which he had access was so small, was limitless.

The thoughts of the dweller in this vague world, as to himself and as to the other beings of which from time to time he became conscious, must have been correspondingly indefinite.

He was, to a degree almost if not quite beyond our power of conception, a spiritualist rather than a materialist; and it is essential to get some idea of the extent and manner of his recognition of spiritual beings—and his corresponding non-recognition of things material.

In passing, I here disclaim, for myself at least, the use of the misleading word "belief" in speaking of the ideas of really primitive man—as, for instance, in the phrase the "belief in immortality." Possibly primitive men of somewhat more advanced thought, though not yet beyond the stage of "savagery," may have "believed" in spirits, in immortality, and so on; but it seems to me that at the earlier stage there can scarcely have been more than recognition (admittedly very strong recognition) of spiritual beings, and non-recognition of any beginning or ending of these spirits.

To return from this digression, Sir E. B. Tylor long since gave currency to the very useful word "animism," as meaning "the belief in spiritual beings," and this has been taken to mean that animism was the initial stage, or at any rate the earliest discoverable stage, of all religion. The primitive Fijian was certainly a thorough-going animist, if his extraordinarily strong but vague recognition of spiritual beings suffices to make him that; but I do not think that the ideas of that kind of the primitive "savage"—or, say, of the most primitive Fijian—before his ideas had been worked up into somewhat higher thought, during the long period while he was secluded in his remote islands, and before the advent of the Polynesians, had developed far enough to constitute anything which could be called "religion," though doubtless they were the sort of stuff which, had these folk been left to themselves, might, probably did, form the basis of the "religion" towards which they were tending.

Practically all human beings—savage and civilised alike—and, though in lower degree, even animal-folk, have in some degree recognised the existence of some sort of spiritual beings. The point, then, seems to be to discover what was the nature of the spiritual beings which the primitive Fijian recognised, but without understanding.

Anthropologists have recently defined, or at least described, several kinds of spiritual beings as recognised (even here I will not use the word "believed") by more or less primitive folk. There is, first, the soul, or the separable personality of the living man or other being; secondly, the ghost, or the same thing after death; thirdly, the spirit, which is said to be a soul-like being which has never been associated with a human or animal body; and, fourthly, there is, it appears, to be taken into consideration yet another kind of spiritual being (or something of that nature) which is the life of personality, not amounting to a separable or apparitional soul, which, it has been supposed, some primitive folk have attributed to what we call "inanimate things."

It seems, though I say this with all due deference, that this identification and naming of various kinds of spiritual beings, though it may hold good of animism at a higher stage, does not fit the case of the more primitive animist (say, that of the Melanesian in the very backward state in which, so far as we know, he first reached Fiji), for presumably he had not as yet recognised or differentiated between the various kinds just enumerated. He recognised something which may be called the "soul," which was the separable personality of the living man or other being. But he did not recognise—perhaps it would be better to say that he had not yet attained to recognition of—the ghost, or the same thing after death; for he had not even recognised any real break, involving change, at death. Nor, as I think, did he recognise a spirit, *i.e.* a soul-like being which had never been associated with a human or animal body; for he had no idea of any spiritual being which did not, or could not, on occasion associate itself with a human, animal, or other material body, nor seemingly had he reached the stage, labelled *animatism*, in which he would have attributed life and personality to things (which I take to mean things which are to us inanimate).

All that the most primitive man would recognise would be that he himself—the essential part of him—was a being (for convenience and for want of a better name it may be called "soul") temporarily separable at any time from the material body in which it happened to be, and untrammelled—except to some extent by the clog of the body—by any such conditions as time and space; he had found no reason to think that in these respects the many other beings of which from time to time he became aware (whether these were what we should class as men, other animals, or the things which we speak of as inanimate, such as stocks and stones, or bodiless natural phenomena, such as winds) differed from himself only in the comparatively unimportant matter of bodily form; moreover, it seemed to him that, as he himself could to some extent do all these, the other beings, and some perhaps even more easily, were able to pass from one body to another.

He felt that these "souls" were only temporarily and more or less loosely attached to the particular material forms in which they happened to manifest themselves at any moment, and that the material form in which the soul (and noticeably this held good even of his own soul) happened at any moment to be embodied was of little or no real importance to that soul, which could continue to exist just as well without as with that body.

Another point which it is important to note is the egoism of the savage man as distinguished from the altruism of the civilised man; for it was perhaps the beginning of the idea of altruism, of duty to one's neighbour, that gave the start to civilisation, and it was because the ancestors of the savage had never got hold of this fundamental principle altruism that they were left behind.

The uncivilised man, complete egoist as he was,

thought and acted only for his own personal interests. It is true that he was to a certain extent kind (as we might call it) to the people of his own small community, and possibly still more kind to such of the community as seemed to him more immediately of his own kindred. But this kindness was little more than instinctive—little more than a way of attracting further service. It is also true that on the occasions, which must have been very rare till a late period in the Melanesian occupation of Fiji, when strangers—*i.e.* persons of whom he had not even dreamed—came, so surprisingly, into his purview, he was sometimes civil or even hospitable to those strangers (it should not be forgotten that to him these were souls embodied by separable accident in material forms); but this would have been only on occasions on which he knew, or suspected, that these visitors were stronger than himself, and able to injure or benefit him.

Another point of great significance in the character of this primitive man was that he had no conception of ownership of property. To him all that we should class as goods and chattels, his land, or even his own body, was his only so long as he could retain it. He might if he could and would take any such property from another entirely without impropriety; nor would he resist, or even wish to resist, the taking from himself of any such property by any one who could and would take it.

Again, the primitive man must have been far less sensitive to pain, and far less subject to fear, than the normal civilised man. I do not mean that the primitive Fijian was without the ordinary animal shrinking from physical pain, but that he cannot have been nearly as sensitive even to physical pain as is the more sophisticated man; nor had he the same mental pain, the same anticipation and fear of pain, that the civilised man has.

Having thus dealt with some of the more important points in the character of the primitive Fijian, I propose next to consider how far these suffice to account for some of the more "savage" conditions under which these islanders when first seen were living.

Cannibalism claims the first mention, in that, though the practice has been recorded from many other parts of the world, it is commonly supposed to have been carried further in Fiji than elsewhere.

Here, however, it is at once necessary to point out that the outbreak of cannibalism in Fiji in the first half of the last century was not due to any innate and depraved taste on the part of the Fijians, and that the practice to the degree and after the fashion of which the story-books tell was not natural to the Fijian, whether of Melanesian or Polynesian stock.

It is probable, even perhaps certain, that all the Fiji islanders occasionally ate human flesh before the coming of white men to the islands; but it was only after the arrival of the newcomers that this practice, formerly only occasional and hardly more than ceremonial, developed into the abominable orgies of the first half of the last century. The first Europeans to set foot—about 1800—and to remain in the islands for any time were the so-called "beachcombers." At first, at least, these renegades from civilisation, to secure their own precarious position and safety, contrived to put themselves under the patronage of some one or other of the great native chiefs, who would be Polynesians, and assisted and egged on these chiefs in their then main occupation of fighting other great rival chiefs, also Polynesians, and raiding the less advanced Melanesians of the surrounding districts. The guns and ammunition which the beachcombers, in some cases at least, brought with them or managed to procure, and the superior craft which they had imbibed from civilisation, greatly assisted them in this immoral purpose. Consequently a habit of cruelty, new to the Fijian, was implanted and developed, especially in the Polynesian chiefs. It became more and more a fashion for the greatest native warriors, thus egged on, to vie with each other in the number of their victims and in the reckless cruelty with which these were killed. Doubtless at first the victims were opponents killed in fight, sometimes great rival chiefs and sometimes mere *hoi polloi* who had been led out to fight, probably not very reluctantly, for their chiefs. Incidentally more and more people were killed; and the bodies of the slain were conveniently disposed of in the ovens. A taste for this food was thus developed in the chiefs—though this seems, for a time at least, to have been confined to the great chiefs, most of those of lower status, and all women, refusing to partake, at any rate until a later period. Before long, when the number of the killed ran short, the deficiency was made up by clubbing more and more even of their own people, until eventually the great native warrior took pride in the mere number of those he had killed and eaten.

It seems probable that even the coming of the missionaries, who first reached Fiji thirty or forty years after the earliest beachcombers, and at once began almost heroic efforts to stop cannibalism, thereby to some extent temporarily even aggravated the evil. For the chiefs, in their characteristic temper of gasconade, killed and ate more and more unrestrainedly, in mockery of the missionaries and to show what fine fellows they thought themselves to be.

To return from this digression into a somewhat distasteful subject, cannibalism as practised by the Fijians before the coming of white man was very different, and, from the Fijian point of view—if I may say so without fear of being misunderstood—not altogether indefensible. It must be remembered that there was, as it were, no killing in our sense of the word involved, merely a setting free from the non-essential body of the essential soul, which soul survived just as well without the body as with it.

Note that the soul must have been considered as in some way and for a time still associated with its late body if, as is commonly and perhaps rightly held, the slayer sometimes ate some part of the body of the slain in order to acquire some of the qualities of the slain.

Again, there can be little doubt that men were sometimes killed for sacrificial purposes, the material bodies of the victims being placed at some spot (perhaps the tomb) considered to be frequented by the disembodied spirit of some ancestor for whom it was desired to provide a spirit attendant. It may be noted that this sacrificial use of the body might be combined with an eating of the same body when once it had served its first purpose of attributing the spirit which had been in it to the service of the honoured ancestor.

It has been laid to the charge of the Fijians (as to that of many other folk of savage and even of civilised culture) that they habitually killed strangers, especially such as had been washed or drifted to the islands by the sea—who, in early times at least, must have been almost the only strangers to arrive. The charge, like that of cannibalism, has been exaggerated, and the facts—as far as there were any—on which this charge was founded have been misunderstood.

Here, again, the attitude of the Fijian in this respect was scarcely different from that of the lower animals in similar circumstances. The Fijian knew of no reason to be glad of the arrival of strangers, unless these could, in one way or another, be useful to him; and, as has already been explained,

he knew of no reason why he should not make the best use possible of the stranger, of his body or his spirit, separately or together.

While, as must have been the case in earlier times, the newcomers were dark-skinned men like himself, the Fijian might without the slightest prick of conscience separate their bodies from their spirits, and dispose of the body or the spirit separately; or without effecting this separation, he might simply enslave the newcomers; or, again, if he suspected that the newcomers were too strong for him, he might yield himself to them as a slave.

And later, when Europeans began to arrive, sometimes as refugees from passing ships and sometimes as survivors from ships wrecked on the surrounding reefs, the bearing of the Fijian towards this new kind of stranger would have been on the same principles, only that in this case the newcomers, being of far less readily understood kind, would be regarded with more suspicion and also more respect. I believe that very seldom, if ever, was an inoffensive white man, wrecked sailor or other, killed, or treated with anything but kindliness and courtesy, even though the wrecked man's property might naturally be appropriated by the natives. It was only when white-skinned strangers became commoner, and frequently more offensive, and when familiarity had bred contempt, that they were killed, as nuisances, and, especially during the great outbreak of cannibalism, were eaten.

This point in the bearing of the islanders to white men might be further illustrated by a circumstance which, to my surprise, I have never found mentioned, *i.e.*, that during the whole period while the missionaries were, with a rashness only justified by the circumstances, testifying against the natives in Fiji not one of these was killed, until at a much later period, when European influence was all but predominant in Fiji, Baker was killed and eaten in very special circumstances.

If it were possible to ascertain in each case the facts as to the reception by "savages" of the first white men they saw, it would almost certainly be found that the reception was apparently kindly, though this kindness may really have been due to fear and not to charity. It was, however, quite probable that at any moment the savage might find that his dread of the white man was unfounded, and in that case he might kill him (*i.e.*, separate his soul from his body) without hesitation, and after doing this his fear—he probably never had any affection for him—of the disembodied spirit of the white man might be as great, or even greater, than before.

Incidentally it may here be noted, as a further curious point, that a Fijian who thus quite remorselessly set free the soul of a stranger from its body would probably not often and not for long in his dreams be revisited by his victim, if a native; and perhaps not even if the victim were a white man, unless very remarkable. In other words, the victim survives only just so long as he is remembered. Captain Cook, we know, survived for very long, perhaps does so still; few, if any, of such beachcombers as were later killed in Fiji survived for any length of time; and the innumerable natives who were drifted or washed to one or other of the islands must for the most part have passed from memory soon after they were killed.

It has been suggested that the killing of strangers may have been for the purpose of preventing the introduction of disease; and it is certain that, perhaps even before the coming of white men, the islanders recognised that the advent of strangers was curiously often and most disastrously followed by the introduction of new diseases, either real diseases or at least some queer, unexplained influence which has so often made life not worth living for savages where white strangers have been.

The Fijians were scarcely more notorious for cannibalism than for theft—and almost as undeservedly. There is scarcely an account of the visit of a European ship in early times to any of the islands which does not mention that the islanders who came aboard took whatever they fancied, either quite openly, or, if furtively, then without evincing anything like shame when discovered. This habit, which the explorers naturally called theft, was but the manifestation of a South Sea custom, due to the entire absence of any idea of personal property, which in Fiji is called keri-keri. To keri-keri was to take whatever you wanted and could take without the previous holder of the property preventing you. In old days no Fijian doubted his own absolute right to keri-keri, nor did he feel the very slightest shame in thus (as we should say) "depriving another of his property," or "stealing"; and even to this day the Fijian, provided that he is not really Europeanised, will keri-keri without shame. In short, the idea of ownership and individual property never occurred to the natural Fijian. He took what he wanted, and was strong enough to take. But, on the other hand, he yielded up, practically without reluctance, whatever another stronger or cleverer than himself wanted and was able to take from him.

Of the many other charges of "savagery" made against Fijians, I can, in the time at my disposal, deal with but one more, that as to their strange and gruesome habit of celebrating great occasions by killing their own folk. When a Fijian chief died, as we should say, or, as it seemed to the surviving natives, when his soul left the body which it had for a time used, his widows, and other of his kindred and dependants, unwilling to be left behind, were strangled, often, indeed, helped to strangle themselves, that their bodies might be put into the graves, while their souls went gladly with that of the chief whom they had been accustomed to follow.

Again, when a chief built a house, some of his dependants, whom the great man told off for the purpose, willingly stepped down into the holes which had been dug for the house-posts, and remained there while the earth was filled in on them, and continued thereafter as permanent supporters of the house.

Again, there is a tradition, which at least was not incredible to the natives, that a great chief one day went a-fishing, and caught many fish. Two brothers of humbler rank who happened to have come down to the same waterside, also to fish, were less successful. The chief, in a characteristic freak of generosity, presented his best fish to the elder of the two brothers, who, strictly according to Fijian custom, accepted the gift, but felt bound to make an immediate return, but he had nothing to give. Thereupon the younger brother, at his own suggestion, was clubbed by the elder, and his body presented to the chief in token that his soul would thereafter serve that chief.

It is even said that when yams and other vegetables were brought in as food for the chiefs by the dependants who had grown them for that purpose, the food-bearers, if there was a scarcity of fish or other suitable accompaniment for the vegetable diet, were themselves clubbed and their bodies eaten. This particular atrocity probably happened only after the habit of cannibalism had, as already explained, been unnaturally intensified. But the story is noteworthy in that the food-bearers are not represented as in any

way dreading or shirking the use to which their bodies were put.

In all these and similar cases it is to be noted that the victims (as we are naturally inclined to call them) were more or less indifferent, if, indeed, they were not eagerly consenting parties, to the use (cruel as it seems to us) made of their material bodies. Thus the widows were eager to be strangled, and often even helped to do the deed, in order that they—all that was essential of them, *i.e.* their souls—should rejoin the deceased. Similarly those others who were killed on the occasion of the funeral were quite willing to give their bodies, which seemed of comparatively little importance, as "grass" to be added to the cut fern and other soft material on which the body of the deceased chief was couched in the grave; and quite willingly the men told off for that purpose stepped down into the holes in which the house-posts were grounded, that they, or rather their bodies, might thereafter hold up the house, while their souls enjoyed life much as before but without the encumbrance of the body. Others, again, contentedly grew *taro* for the chiefs to eat, and carried it in when ripe, thinking it of little importance that their mere bodies might be eaten with the *taro*.

In conclusion, having endeavoured to realise for myself, and to show you a glimpse of the enormous, scarcely conceivable difference in habit of thought, and consequently in character, which separates the savage from the civilised man, I will offer a suggestion which seems to me possibly the most important outcome of my personal experience, now closed, as an anthropological administrator in tropical places where Eastern and Western folk have met, and where the inevitable clash between the two has occurred.

In such places and circumstances the result has too often been that sooner or later the weaker folk—those whose ancestors have been age-long "savages"—have died out in the presence of those whose ancestors long ago turned from "savagery" to civilisation. This dying out of the weaker folk has happened even when the stronger people have done their best to avoid this extirpation.

The real ultimate cause of "the decrease of natives" when in contact with civilised folk lies, perhaps, in the difference in hereditary mentality—in the incapacity of the "savage" to take on civilisation quickly enough. However sedulously the missionary, the Government official, and others who take a real interest in so doing, may teach civilised precepts to the essential savage, the subject of this sedulous case—however advanced a savage culture he may have attained—will, at least for many generations, remain a savage, *i.e.* for just so long as he is under influence of the civilised teacher he may act on the utterly strange precepts taught him, but away from that influence he will act on his own hereditary instincts.

The manner in which the native dies out—even when well looked after—varies. He may be killed out by some disease, perhaps trifling, but new to him, with which he does not know how to cope, and with which—if he can avoid so doing—he simply will not cope in the ways which the civilised man would teach him; or he may be killed out by the well-meant but injudicious enforcement on him of some system of unaccustomed labour; or, again, he may die out because deprived of his former occupations (*e.g.* fighting and the gathering of just so much food as sufficed for him) and thus restricted to a merely vegetative existence; or in many other more or less similar forms his extermination may come about.

But all such effective causes are reducible to one, which is that he is not allowed to act on his own hereditary instincts, that he cannot at all times have, and often would not use, judicious and disinterested guidance from civilised folk, and that consequently he, the "savage," cannot and too often does not care to keep alive when in the presence of civilised folk.

SECTION I.

PHYSIOLOGY.

OPENING ADDRESS BY PROF. BENJAMIN MOORE, M.A., D.Sc., F.R.S., PRESIDENT OF THE SECTION.

The Value of Research in the Development of National Health.

THE history of medical science presents to the curious student a remarkable development commencing in the latter half of the nineteenth century, and one worthy of special study, both on account of the light that it sheds on the present position and the illumination it affords for future progress.

If any text-book of medicine or treatise on any branch of medical science written before 1850 be taken up at random, its pages will reveal that it differs but little from one written a full century earlier. If such a volume be compared with one written thirty-five years later, it will be found that the whole outlook and aspect of medicine have changed within a generation.

Erroneous introspective dreams as to the nature of diseases, as "idiopathic" as the many strange maladies which their authors are so fond of describing have been replaced by fast-proven facts, and medicine has passed from an occult craft into an exact science based upon experimental inquiry and logical deduction from observation.

What caused this rapid spring of growth, after the long latent period of centuries, and are we now reaching the end of the new era in medicine, or do fresh discoveries still await the patient experimentalist with a trained imagination who knows both how to dream and how to test his dreams?

It is but a crude comparison that represents the earlier age as one of empiricism and imagination, and the later period as one of induction and experiment. Empiricism has always been of high value in science, it will ever remain so, and some of the richest discoveries in science have arisen empirically.

Imagination also is as essential to the highest scientific work to-day as it was a century ago, and throughout all time the work of the genius is characterised in all spheres of human endeavour by the breadth and flight of the imagination which it shows. The great man of science, whether he be a mathematician, a physicist, a chemist, or a physiologist, requires imagination to pierce forward into the unknown, just as truly as does the great poet or artist. Also, the inspired work of poet or painter must be concordant with a system of facts or conventions, and not outrage certain canons of his art, as certainly as the true and lasting work of the man of science must accurately accord with natural laws.

The man of science is as little able to prove the fundamental truth or existence of the groundwork upon which modern physical, chemical, and physiological theories are built, as the artist is to prove the ethics, or perfect truth, or perfect beauty, of those conventions upon which poetry, painting, or that great group of studies termed the "humanities" find their basis. But the artist or philosopher knows that, using these conventions as the best at present discovered, he can produce works of which the beauty and consistency appeal to all educated human minds capable of appreciation. Similarly, the conventions of natural science, properly understood, appeal to the

imagination of the man of science, call forth new ideas to his mind, and suggest fresh experiments to test those ideas; or, a chance empirical observation of an experimental nature, which without theory and scientific imagination would remain isolated and sterile, placed in relationship to the rest of the scheme of science, awakens thought, and may lead to a fresh departure and a long train of important discoveries.

It was this correlation of the imagination with experimentation and the tracing out of relationship from point to point so as to develop the evolution of phenomena that characterised the science of medicine when new-born about seventy years ago, and differentiated it from the older nosological medicine in which imagination and experimentation, while both existing, seemed to possess independent existences and pay little regard the one to the other.

It seems well-nigh forgotten nowadays by the majority of people that science and religion originally began together from a common thirst for knowledge, and usually in the same type of mind endowed with a divine curiosity to know more of the origin and nature of things.

Every great religion worthy of the name contains some account of the natural history and creation of the world, in addition to its metaphysical aspects, and reflects the degree of knowledge of natural science possessed by the nation in which it arose at the time of its birth.

The fundamental error throughout the ages of human conceptions both in science and religion was that of a non-progressive world to which a stereotyped religion, or science, could be adapted for all time. Perfection was imaged where perfection, we are now happy to realise, was impossible, and, believing in this imaginary perfection and that all things new deviating from it were damnable, men were prepared to burn one another at the stake rather than allow error to creep into the world in either science or religion. Thus there have been martyrs for the scientific conscience just as for religious belief, and at this distance in time we can perhaps better understand both inquisitor and martyr and realise that both were fighting for great ideals.

Evolution has taught us that as knowledge broadens we must be prepared to have wider vision and abandon old theories and beliefs in the new-born light that makes the world better to-day than it was yesterday, and that also will show things up to our mental vision more clearly to-morrow than they stand out to-day. To the members of any great craft, or profession, or religious order, this scientific outlook which accepts as fundamental a progressive world, and insists that its votaries should adapt their lives to such a doctrine, is peculiarly difficult of assimilation. Routine fixes all men, and so when any new discovery appears to demand change from that order to which the mind has become accustomed, it is immediately looked upon with suspicion, and there being little plasticity of mind remaining, it is rejected as heretical or revolutionary after but scant critical examination. The cry of the craft in danger has been used efficaciously on many occasions since the days of the Ephesian silversmiths, nor is such a cry at once to be set down to pure selfishness. A craft is often worth preserving long after the forces which have called it into being have commenced to slumber, and conservatism of this type is at times an important factor in social progress. However, there are certain limits which must not be surpassed, room must be made by adaptation for the new knowledge, or it will establish a craft of its own iconoclastic to much worth preserving in the older system.

It is important to insist upon these limitations, because a too reactionary spirit abroad in medicine between 1860 and 1880 prevented the world from benefiting from those remarkable discoveries by Pasteur and their proposed applications by Lister, which laid the foundations of modern medicine and modern surgery. These pioneers of the new age in medical science had to wage for many years a stern and bitter fight against the strong forces of ignorance and prejudice. But for this illogical resistance by men who would not even test the new discoveries, and instead spent their time in sneering at the new geniuses who had leadership to give the world, France and Germany would have been saved many thousands of brave lives in the great war of 1870–71. Even thereafter, the slow struggle continued of the few who knew against the many who refused to be taught, and a perusal of any orthodox text-book of medicine published between 1875–80—that is, more than a decade after Pasteur's great discovery—will show that the etiology of scarcely a single infectious disease had become known, and that medical science was, for example, as ignorant of the nature of tuberculosis as we are to-day of the nature of carcinoma. Take, as an example, the following quotation from a well-known text-book of the theory and practice of medicine published in 1876: "It is now, however, generally admitted that tubercle is no mere deposit, but, on the contrary, a living growth as much as sarcoma and carcinoma are living growths." The tubercles were the only initial lesion observed, the infecting organism was entirely unknown, and the pathologists of this comparatively recent date argued at length as to whether tubercles were to be classed as "adenomata" or were something *sui generis*.

There is a gleam of sunlight for the future in this retrospect at the ignorance of the past, for, if men were as ignorant regarding tuberculosis thirty-eight years ago as to-day they are about cancer, then it may be argued that a generation hence as much may be known about cancer as is known now about tuberculosis.

It is particularly important at the present moment, when so much interest is being taken in national health, to point out the urgent necessity of allowing as little lagging behind as possible to ensue between the making of discoveries and the practical application of the results by organised national effort for the well-being of the whole community.

It must sadly be admitted that it is craftsmanship in imaginary danger fighting hard for the old methods unchanged which were in vogue fifty years ago that stands most prominently in the way of advance. As great a harvest as that which followed the application of the principle of antisepsis in surgery awaits the application of the self-same principle in national sanitation to-day, but the very profession which ought to be urging forward the new era apparently stands in dread of it, and seems to prefer to reap its harvest from disease rather than to seize the noble heritage won for it by the research of pioneers and so stand forth to the world as the ministry of health. Fortunately it cannot be, the bourne has been passed, and there is no going backward. The advances that have already been made have awakened statesmen and people alike to the needs of the situation, and all have resolved to be disease-ridden no longer. The laws of health must be made known to the people at large, and schemes laid before them for a national organisation for the elimination of disease. Disease is no longer an affair of the medical profession, it is a national concern of vital importance. The problem is not a class question, all humanity stands face to face with it now in the light of modern research as it never has faced it before. It has been realised that disease never can be conquered by private bargains for fees

between individual patient and individual doctor. Research into diseases of unknown causation cannot be subsidised upon such individualistic lines, and in the case of diseases of known etiology and modes of propagation, the passage of disease from individual to individual cannot be controlled by such private methods as that of the afflicted individual subsidising the doctor for his own protection. Cost what it may, a healthy environment must be produced for the whole mass of the population, and the laws of physiology and hygiene must be taught not only to medical students, but to every child in every school in the country. People cannot live healthy lives in ignorance of the fundamental laws of health merely by paying casual visits to physicians, and no one class in the community can be healthy until all classes are healthy.

The problem of national health is one of peculiar interest to physiologists, and to the exponents of those experimental branches of medical science which have sprung from the loins of physiology, for it was with them that the new science of medicine of the last fifty years arose, and they ought to be the leaders of the world in this most important of all mundane problems.

It is well worth while to consider our opportunities and responsibilities and raise the question whether our present system and organisation are the most suitable for attaining one of the most sublime ambitions that ever appealed to any profession. By definition, our science studies the laws of health and the functions of the healthy body, therefore it is ours to lead in the quest for health. Is this object best achieved if we confine ourselves to research in our laboratories, and to the teaching of the principles of physiology to medical students, while we leave the community as a whole uninstructed as to the objects of our research and its value to every man, and trust the medical students whom we turn out to communicate, or not communicate as they choose, the results of their training and our research to the world at large?

There is little question that much of the ignorance abroad in the world, and much of the fatuous opposition to our experimental work and research, arise from this aloofness of ours. Here also lies the cause of much of the latent period in the application of acquired knowledge to great sociological problems, and the presence of untold sickness and death which could be easily prevented if only a scientific system of dealing with disease could be evolved.

The position occupied by men of science in medicine at the present day is largely that of schoolmasters to a medical guild, and even at that, one constructed upon lines which have grown antiquated by the progress of medical science. It ought now to become the function of the man of science to re-model the whole system so as to fight disease at its source. The whole situation at the moment calls out for such a movement. On the one hand, there exists a widespread interest on the part of an awakened community in health questions, evidenced by recent legislation dealing with the health of school children, with the health of the worker, with the sanitary condition of workshops, with the questions of maternity and infant mortality, and with the communication of infectious diseases. On the other, there is chaos in the medical organisation to meet all these new demands, and the ample means recently placed at the command of the nation and of municipal authorities are being largely wasted by overlapping and misdirection for lack of skilled leadership. Surely it is a time when those who have laid the scientific foundations for the new advances should take counsel together, assume some generalship, and show how the combat is to be waged, not as a guerilla warfare, but as an organised and coordinated campaign.

There are two essentials in the inception of this organised campaign against disease on a scientific basis. The first is to demonstrate clearly to the public mind that modern scientific medicine arose from the experimental or research method, that it was only when experimental observation of the laws of health and disease, in animals and man, commenced on an organised and broadcast basis that medicine and surgery leaped forward and the remarkable achievements of the past fifty years began. Also that it is only by the organisation and endowment of medical research that future discovery and advancement are possible. The second essential is to convince the public that a national system must be evolved placing medical science and medical practice in coordination, so that the discoveries of science may be adequately applied in an organised scheme for the prevention and treatment of disease. The method in which discoveries have been made in the past suggests an amplification and organisation along similar lines for the future, and the banishment of many diseases by public health work in the past suggests that it is more efficiently organised and widespread public health work in the future, extended from the physical environment to the infecting individual, that will be most fruitful in banishing other diseases.

If it be queried by anyone here, what has physiology to do with disease, it may be replied that the question comes at least fifty years too late. The methods evolved first by physiologists in experimentation upon animals have become the methods of all the exact sciences in medicine. Bacteriology is the physiology of the bacterium, and the study of protozoan diseases the physiology of certain groups of protozoa. Organotherapy had its origin in physiology, and many of its most brilliant discoveries were made by physiologists, and all by men of science who used physiological methods. Serum therapy, experimental pharmacology, and the great problems of immunity all arose from the labours of men with expert training in physiology who branched out into practical applications achieved by the extension of the experimental, or research, method. The modern methods of medical diagnosis and the brilliant technique of contemporary surgery, what has opened the door to these but the experimental method? From the days of the first successful abdominal operation to the present day, research in laboratory or in the operating theatre has pioneered the way, and the sooner this simple truth is known to all men the better for medical science. Every time any surgeon first tries a new operation there is in it an element of experiment and research of which the ethical limits are well known and definable, and any person who logically thinks the matter out must see that it is the research method which has placed the science and art of surgery where it stands to-day. Exactly the same thesis holds for medicine. How could any physician predict for the first time, before he had tried it experimentally on animal or man, the action of any new drug, the effect of any variation in dosage, the result of any dietary, of the employment of any course of physical or chemical treatment, or of anything in the whole of his armamentarium? Yet the public are rarely told any of these wholesale truths, but are rather left to speculate that each medical and surgical fact sprang forth as a kind of revelation in the inner consciousness of some past genius in medicine or surgery, who, in some occult way, knew of his own certain foreknowledge what would be the definite effect of some remedy or course of treatment before he tried it for the first time on a patient, or perhaps had the ethical conscience and genuine humanity to test it

on a lower animal before he administered it to man.

It may, in short, be taken as an axiom of medical science that everything of value in medicine and surgery has arisen from the applications of experimental research. Nor can future advance be made by any other method than the research method. It is true that accident may teach occasionally, as it did, for example, in the dreadful burns unwittingly inflicted on themselves and patients by the early experimenters in X-ray therapy and diagnosis. But accident is only the most blundering type of experimentation, and results obtained by its chance agency do not really invalidate the universal law that man only learns by experience, or, in other words, by research. Research is, after all, only the acquisition of fresh experience by the trained expert, usually led on to his experiment by inductance from other known facts.

It has been said above that all that is valuable in medical science has been acquired by research; the converse may now be pointed out, that much that was valueless, dangerous, and even disgusting in medicine in earlier days was incorporated into the medical lore of the time, and often remained there for generations, stealing lives by thousands, because physicians had not yet adopted the research method, and so based their practice upon ignorant and unfounded convention. It is noticeable in literature that up to somewhere in the beginning of the nineteenth century physicians and surgeons were often as a class looked upon by scholars and educated people with a certain amount of contempt. There were notable and fine exceptions in all ages, but, taken as a whole, the profession of medicine was not held in that high esteem and admiration that it is amongst all classes to-day. Take, for example, Burns's picture of Dr. Hornbrook, or Sterne's account of Dr. Slop in "Tristram Shandy," and similar examples in plenty are to be found in the Continental literature. The reason for the change is to be found in the comparative growth of medical science as a result of the research method. The physicians of those days were very often ignorant quacks employing the most disgusting and dangerous remedies, or methods of treatment, based upon no experimental knowledge and handed down in false tradition from ignorant master to ignorant and often almost illiterate apprentice. It is only necessary to peruse the volumes written on *materia medica* of this period to shudder at the nature of the remedies apparently in common use; the details are unfit for modern publication.

Even in the first half of the nineteenth century patients were extensively bled almost to exhaustion in a vast variety of diseases in which we now know with certainty that life would be endangered by such treatment and chance of recovery diminished. Thus, in a text-book published in 1844 by the professor of medicine in the most famous university in medicine of our country, and a physician in ordinary to her Majesty Queen Victoria, it is said that in the treatment of pneumonia "the utmost confidence may be placed in general blood-letting, which should always be large, and must almost always be repeated sometimes four or six times, or even oftener. Blistering and purging, under the same cautions as in the bronchitis, are to be employed; and two other remedies have been much recommended—opium, especially combined with calomel, and the solution of tartar emetic." It seems scarcely credible to us nowadays that about this same period a low diet, blood-letting, emetics, and purgatives were employed as a treatment in phthisis; yet such is the case. It is in keeping with the above, and in strange contrast to modern treatment, to find it recommended that if the patient cannot winter abroad he is ordered "strict confinement within doors in an artificial climate, as near as possible to 60° Fahr., during at least six months of the year in Britain." From the text-books of medicine of this period, only seventy years back, instances of wrongful and even dangerous treatment in most of the important diseases might be produced. There is no basis of accurate scientific knowledge of physiology, biochemistry, or bacteriology underlying the visionary notions about disease. The real causes of the diseases being obscure, they are commonly set down to so-called diatheses or habits such as the "hæmorrhagic diathesis" or the "scrophulous habit." Also, the action of infective organisms and the intimate relationships in regard to infection of members of the same family being unknown or forgotten, such "habits" are erroneously set down as hereditary. When there is no other channel of escape, the word "idiopathic" is coined to cover the ignorance of the learned.

If now we pass onwards about thirty years in time, halving the distance between the above period and our own time, and consult an important text-book of medicine published in 1876 by a fellow of the Royal College of Physicians, a physician and lecturer at a famous London medical school, and a lecturer on pathology and physiology, we find that the progress attained by research in physiology and physiological chemistry, and a growing belief in the possibility of infection in many diseases by the micro-organisms, now demonstrated so clearly in certain cases by Pasteur and his followers, have commenced to do their beneficent work in medical practice. The heroic bleedings and leechings and the scarcely less violent druggings with strong drugs have disappeared. The patient is less harassed by his doctor, who is more content to assist the natural processes of recuperation as his knowledge of applied physiology and hygiene teach him, rather than to thwart them and to lessen resistance as his predecessor often did a generation ago, when he knew no physiology and less hygiene. Still, the comparison between the text-book of even forty years ago and one of the present day shows a wonderful advance, all flowing from the use of the research method in the intervening years, both in knowledge of the origins and in the treatments of the diseases.

Time and space forbid going into details, but the whole of serum-, vaccine-, and organo-therapy were unknown, with the single exception of vaccination for variola. Enteric fever has been separated from typhus, but its etiology is still obscure, and, to a large extent as a consequence, the mortality from it is 15 to 16 per cent., or quadruple present-day figures, and it is one of the commonest of diseases. The cause of diphtheria is unknown, although it is now recognised as a "contagious" disease, and as yet research in bacteriology has supplied no cure for it. The unity of the various forms of tuberculosis is unsuspected, the infecting organism is unknown, and, as a result, it is not even recognised as an infectious disease, and heredity figures most strongly in a dubious etiology, leading up to a vacillating treatment. Pneumonia is not recognised as due to a micro-organism, and is described as one of the "idiopathic" diseases. The cause of syphilis, and its relationship to *tabes dorsalis*, and general paralysis are unknown, and generally it may be said that the causes of disease are either entirely unknown or erroneously given in at least three-quarters of the very incomplete list of diseases that are classified and described.

This, after all the centuries, was the doleful position of medical science in the year 1876, when suddenly light began to shine upon it, brought not by the agency of any member of the medical profession, but by a physiological chemist, and he was led to his great discovery, not in an attempt to solve some problem of practical medicine, but by scientific observations devoted to an apparently purely philosophical critical research into the supposed origin of life in a particular way.

It was the experimental or research method in biochemistry supported by physiological experiments on animals which, in the hands of Louis Pasteur, laid the foundations of true knowledge, and transformed medicine from what has been described above into the glorious, living, evolving science that we possess to-day.

The men who fought side by side with Pasteur in his famous struggle against orthodoxy in medicine as represented by the leading physicians and surgeons of the period between 1860 and 1880 were mainly chemists, biologists, and physiologists, such as Claude Bernard, Paul Bert, J. B. Dumas, Biot, Belard, and Sainte-Claire Deville, in his own country, and Tyndall and Huxley in ours. A few physicians and surgeons of scientific training in France and England recognised the importance of his discoveries, such as Alphonse Guérin, Villemin, and Vulpian, in his own country, while Lister in ours was already at work, had experimented widely and wrote his memorable letter of congratulation to Pasteur in 1874, informing him of the work he had been doing in introducing antiseptic surgery in England during the preceding nine years. Against this intrepid little band of experimental men of science were massed all the batteries of orthodox medical nescience served by the distinguished physicians and surgeons of the time; but truth is mighty and must prevail. Davaine applying Pasteur's principles in a medical direction had found out the bacterial origin of anthrax, and although he was violently attacked by oratorical arguments in opposition to experimental proofs, and accused, as many physiologists are to-day, of having "destroyed very many animals and saved very few human beings," his facts held fast, and combined with the later experiments of Koch and of Pasteur, not merely established the etiology of anthrax as we know it to-day, but gave a support and forward growth to that new-born babe, bacteriology, which without such animal experiments could never have grown into the beneficent giant that it is to-day in all its glorious strength for the weal of humanity.

Pasteur himself meanwhile was hard at work in the small ill-equipped laboratory of physiological chemistry of the Ecole Normale at Paris, from which the fame of his discoveries began rapidly to spread and shed a new light forth on the medical world. Pasteur at this stage had already largely rehabilitated the national prosperity of his own country by his successful researches on silk-worm disease and on fermentation maladies and the diseases of wines. All this effect upon national industries, it is to be noted, followed on from an inquiry of apparently no practical importance on spontaneous generation. He now turned his genius towards disease, there also utilising the same discovery arising from a research that contained at first sight no possible applications to disease, and the remainder of his life was devoted to the extension of these studies. The subsequent history of this discovery is the science of bacteriology with all its ramifications and manifold applications in industry, in agriculture, in medicine, and in public health, investigated by the experimental method by thousands of willing workers all over the civilised world. Who but the ignorant Philistine, who knows not what he prates about, can deny the profound influence of animal experimentation, and the philosophic application of the principle of research upon the history of the world?

Let us now, from the vantage-point of the present, look back at the past and glean from the study of the manner in which this science took origin some knowledge to guide us, first, as to how research may be fostered and encouraged in the future, and, secondly, as to how the results of research may be applied for social advantage.

The first and perhaps the finest thought of all is that research must be pursued with the highest ideals of the imaginative mind apart from all desired applications or all wished-for material advantages. If we might personify nature, it would seem that she does not love that researcher who only seeks her cupboard, and never shows her finest treasures to him. She must be loved for her own beauty and not for her fortune, or she will ne'er be wooed and won. Not even the altruistic appeal of love for suffering mankind would seem to reach her ears; she seems to say: "Love me, be intimate with me, search me out in my secret ways, and in addition to the rapture that will fill your soul at some new beauty of mine that you have discovered and known first of all men, all these other material things will be added, and then I may take compassion on your purblind brothers and allow you to show them these secret charms of mine also, so that their eyes may perchance grow strong, and they, too, led hither by you, may worship at the shrine of my matchless beauty." By all the master discoveries in all the paths of science, nature is ever teaching us this great doctrine to which we have closed our ears so long. She tells us the creation of the world is not finished, the creation of the world is going on, and I am calling upon you to take a part in this creation. Never mind that you cannot see the whole, love that you see, work at it, and be thankful that I have given you a part to play with so much pleasure in it, and so doing you will rise to the highest ideal.

This is religion with thirst for knowledge as its central spring; does it differ much from those aspirations which have made men of all nations worship throughout all the ages? Anthropology teaches us that the religious system of a race of men gives a key to their advancement in civilisation. If this be so, growth in natural knowledge must elevate our highest conceptions, furnish purer ideals, and give us more of that real religion that is to be found running so strongly in the minds of great individuals, such as Isaac Newton, Michael Faraday, Louis Pasteur, Auguste Comte. A great man may be strongly opposed to the orthodox creeds of his day, he may even sneer at them, he may be burnt at the stake by their votaries, and yet be a man of strong religious feelings and emotions which have furnished the unseen motive power, perhaps unsuspected even by himself, that leads to a whole life of scientific heroism and enthusiasm.

The practical lesson for us to learn from all this is that we must consider research as sacred and leave it untrammelled by fetters of utilitarianism. The researcher in functional biology, for example, must be left free to pursue investigations as inspiration leads him on any living structure from a unicellular plant to a man, and must not be expected to devise a cure for tuberculosis or cancer. In his research he must think of something higher even than saving life or promoting health, or he is likely to prove a failure at the lower level also.

As an example of the wrong attitude of mind towards science, there may be taken the point of view of those utilitarians who complain of the amount of time and discussion at present being given to

the problem of the origin of life. These wiseacres with limitations to their brains say "that is an insoluble problem, we shall never get to the bottom of it, let us simply assume, since it is here, that life did originate somehow, and, taking this as an axiom, proceed to some practical experimental problem; the origination of life does not lend itself to experimental inquiry."

Now it is, strange to say, just those problems that appear most insoluble upon which the inquiring type of mind loves to linger and spend its energies, and, although the problems never may be solved, the misty solitudes to which they lead are glorious and the fitful gleams of half-sunshine that come through are more kindling to the senses of such men, than the brightest sunshine on the barest of hills. It is here, and in such quests, that the biggest of human discoveries are made, and not all of them are in natural science alone.

The search after the mystery and origin of life had profound influence in raising man from a savage to a civilised human being, and is found as an integral part in all religions above a certain level of savagery. Much of the system of morals and ethics of civilised nations is unconsciously grouped round this problem, and we owe the existence of that social conscience which makes each of us our race's keeper to our interest in the nature of life, and our ties with other lives. Leave such a problem alone and attend to routine researches! Why, the human intellect cannot do it, such problems compel attention! What, it may be asked, was it that started all this routine research in biology, in favour of which we are asked to abandon the search after the origin of life? The routine research would not exist, but for a discovery made in investigating whether life originated in a certain alleged way.

If the whole science of bacteriology emerged from a proof that a certain alley did not lead to the origin of life, how much more glorious may that knowledge become that finally leads us to this goal, or even one step onward in our true path towards it. The search after the origin of life is an experimental inquiry, it leads straight to research, that is all the physicist or chemist demands of a theory; it should be enough for the biologist. We who search for this are not occultists, whatever may be said of those who oppose.

Let us then learn to have a catholic spirit about research, and try to convince the world that it commands devotion, not merely because of material advantages which it may bring, but because it is the most lovely and most holy thing that has been given to man. So may we clear the fair name of science of the false charge of materialism that is so often brought against it by those who do not know and judge science purely by mechanical inventions.

Next let us consider the applications of scientific discovery and see if we cherish aright the gifts of the fairy godmother, for her gifts are dangerous if wrongly used. Consider, if this be doubted, the enormous advantages given by mechanical and chemical contrivances in producing the material comforts necessary to civilised human existence, and then turn your eyes to the reeking slums of our great cities. It is clear that natural science cannot go on successfully alone, it must take sociology with it if our world is to be a better world to live in because of the gifts brought by scientific discovery.

Nor is the ideal and the outlook different in the least from that given above for pure research, when we come to consider its applications, the same high spirit must prevail in all our endeavours, or we shall defeat our own ends and miserably fail. Selfishness here, as everywhere, must recoil on the culprit, who only deadens his own soul. Health is needed not to grow wealthy or to prolong to greater length a "lingering death," as Plato puts it, but to fill life with happiness, and beckon the bold and adventurous forward to higher things. Here we must copy nature's own plan and take care of the race as a whole instead of spending our energies upon single individuals or favoured classes. Nor need anyone fear that any individual or any particular class in the community is going to suffer from the adoption of the true scientific attitude towards disease. The penalty taken by nature on the more comfortable classes who have hitherto enjoyed the greater share in government for allowing the existence of poverty, disease, and slumdom, is to utilise this neglected area as a culture-ground for diseases, which invade the classes above. Nature is still at work creating, still conducting evolution at the highest level, and disease is at present the tool with which she is working. So long as those poverty-stricken slums are allowed to remain, just so long is she grimly prepared to take her toll of death and suffering from those who ought to know how to lead on and do it not. The disease and the crime below are to the social community what pain is to the individual, and just as the special senses become more highly organised and sensitive as the nervous system becomes more highly developed, so as the civilisation of the community intensifies does the public conscience awaken to forms of mischief and crime in one generation that were unsuspected in a previous one. So social evils become intolerable and finally are removed. How then are we employing our knowledge as to the causation of disease to the public problem of its removal or abatement?

In regard to the physical environment much has been done during the past generation towards applying the laws of hygiene, as is shown in the sanitation of our great cities, and especially in regard to the question of water-supply. It is good, for example, that Glasgow goes to Loch Katrine for her water-supply, Manchester to the English lakes, and Liverpool to the Welsh hills. Each of these great cities carries for many miles the pure distillate of the hills to its million of inhabitants. It has cost much in pounds sterling, though not more than if each family had a pump in its backyard. On the other hand, think of the disease and suffering and death prevented, enteric fever almost gone where thousands would have died of it, and tens of thousands been debilitated, and these of the best of the citizens, for disease is no eliminator of the unfit. Think of all this, and then say, Did it not pay these great cities to bring the pure water from the lakes in the hills?

But why do these good cities content themselves to allow their little children at a most susceptible age to be supplied still with milk which contains the bacillus of tuberculosis in so large a percentage as 5 to 10 per cent.? And why does the law of the land prevent these corporations from searching out tubercular cows in all the areas supplying them with milk? If it is part of the business of a municipality to see that its citizens have a pure water-supply, why should it not also be allowed to see that they have a clean milk-supply?

Long ago the power to make the lame to walk was regarded as a divine gift. When is mankind going to awake to the fact that science has placed this gift in its hands? Much more than half of the lame and spinally-deformed children in our midst are in that condition because of infection of joints or spine with the bacillus of tuberculosis. By open-air hospitals and open-air schools we seek and succeed in curing a per-

centage of them, but how much better it would be if we took the fundamental problem of tubercular infection in hand and prevented them from becoming lame and deformed.

There is at present on foot in England a great scheme to enable the blind to read, and it deserves our support because it is our fault that these people are blind. The sad fate of the man born blind appeals to all kind hearts; but men are not born blind, they become blind within a week or two of birth because of an infectious disease contracted from the mother at birth. Science knows and has taught the world how this blindness can be quite prevented, and it is because of our faulty organisation for attending to maternities amongst the poor that these people are blind. By proper organisation practically all blindness arising at the time of birth can be prevented. Why is it not done? Thus our modern science can make the blind to see and the lame to walk, but it is so manacled by ancient ways and customs that it is left powerless, and so there are these maimed and darkened lives of innocent people, and they are left partially burdening the community which has only its own folly to blame for the whole stupid position.

Let us consider lastly a disease which collects the last toll from one-seventh of humanity, and debilitates and enfeebles the lives of many whom it does not entirely destroy. At all ages, in infancy, in the prime of life, and in life's decline, it snatches away the best of our fellow-men. How are we organising our campaign against tuberculosis? Bacteriology has taught us that it is an infectious disease and has isolated the organism. It is an undoubted fact, proven to the hilt by many inquiries and observations, that infection passes from individual to individual. How is this knowledge being applied, and how are we attempting to stem the tide of infection? In the United Kingdom alone about 70,000 persons die annually of the disease, and all over the civilised world the total death-roll of human kind annually from tuberculosis probably does not fall short of a million souls. This tide of infection is kept up, year in, year out, and every 70,000 dying annually in Britain must have infected 70,000 fresh victims before they themselves are carried away. Can it not be stopped, this foul tide of infection? What is being done to stop it? Sanatoria are being provided for the early cases, the bad and most infectious cases are largely being left alone to sow infection broadcast and then die. This is the chief means being used at present to stop the tide. The early non-infectious case is deemed the more important to look after, and the well-advanced, open, thoroughly infectious case is left to itself to infect others and then to die. This is the condition of our public health attitude in regard to tuberculosis. It is a travesty on the application of all biological laws, and in direct opposition to all laws of racial preservation. Industrial conditions have produced an artificial environment and enhanced the chances of infection by the organism of this disease; it should be our plan to copy nature's method and safeguard the interests of the community, and to do this we must proceed on the plan of separating the source of infection—that is to say, the infectious individual from the sound individual. This is done with success in the case of smallpox and cholera, and this plan has eradicated hydrophobia; why should it not be carried out in the case of tuberculosis? Under present conditions men, women, and children are going on unwittingly infecting one another by the thousand with tuberculosis in school, workshop, and home, and we who know it take no public action and raise no clamant outcry against it. It is of more value to the community to isolate one pauper far advanced in tuberculosis than to send ten early cases to sanatoria. This disease must be stopped at its source as well as dealt with on its course. No disease has ever been eradicated from a community by discovering cures for it, and none ever will; many diseases have disappeared because their sources have been cut off.

Let us be scientific, let us search out the truth; having found it, let us act upon it, and let us conceal nothing that is true.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—In consequence of the conversion of the new buildings at Edgbaston into a base hospital during the war, arrangements are being made whereby as much as possible of the work usually carried on there will be continued in Mason College and the Municipal Technical School. Unfortunately, some of the laboratory work will have to be curtailed, and much research work will be suspended.

The hostel for women students is at present used to accommodate the nursing staff of the hospital, but arrangements are being made to provide temporary quarters for the evicted students in a private house in Edgbaston.

The following notice of resolutions passed by the council on September 4 has been issued by the Vice-Chancellor:—(1) That the University will, so far as possible, continue its work for the benefit of those students who are prevented from undertaking active service in the Army or Navy, but that the University's advice to members of the staff, students, laboratory, and other assistants, and college servants, who are of suitable age and physically fit, is that they should enlist and serve their country. That students who propose to enlist should consult the Vice-Principal or the dean of the faculty of medicine, and (if minors) should obtain the written consent of their parents or guardians before sending in their applications. (2) That with a view of encouraging enlistment, the University undertakes to allow leave of absence to any of the above-mentioned persons during their naval or military service; that they be reinstated on their return with no loss of position or emoluments consequent on their enforced absence; that the council pay them (or such other person or persons as they may appoint) such sums as with the pay and allowances they receive from the Government will make up their full salary or wages; and that students shall be entitled to postpone any scholarships or other aids which they may hold, and, where possible, may be allowed to shorten the time of attendance at lectures necessary for a degree, without, however, the remission of any essential requirements in respect of examinations prescribed for their course.

MR. L. J. GOLDSWORTHY has been appointed professor of chemistry at the Victoria College of Science, Nagpur.

DR. D. WATERSTON, professor of anatomy in King's College, London, has been appointed to succeed Prof. J. Musgrove as Bute professor of anatomy, University of St. Andrews.

FOUR Gresham Lectures on heredity will be delivered on October 6, 7, 8, and 9, by Dr. F. M. Sandwith, at Gresham College, Basinghall Street, E.C. The lectures are free to the public, and will begin each evening at six o'clock.

THE Merchant Venturers of Bristol have decided to offer to engineering students of Belgian universities,

or of the University of Lille, free places in the faculty of engineering of the University of Bristol, which is provided and maintained in their college. Of course, many of these students are at present serving with the respective armies, but it is hoped that any students who were unable to serve and who are, at present, in England will avail themselves of this offer.

THE new session of the Sir John Cass Technical Institute, Aldgate, E.C., which is especially devoted to technical training in experimental science and in the artistic crafts, will commence on Monday, September 21. The instruction in experimental science provides systematic courses in mathematics, physics, and chemistry for London University examinations, in addition to the courses on higher technological instruction, which form a special feature of the work of the Institute. In connection with the latter, several new departures are being made for the coming session. The curriculum in connection with the fermentation industries has been much developed and now includes courses of instruction on brewing and malting, bottling and cellar management, brewery plant, and on the micro-biology of the fermentation industries. A connected series of lectures dealing with the supply and control of power has also been arranged to meet the requirements of those engaged in works connected with chemical, electrical, and the fermentation industries. In the department of physics and mathematics a special course of lectures and demonstrations will be given on colloids, which will deal with the methods employed in their investigation and their relation to technical problems; also special courses of lectures on the influence of surface-tension on chemical phenomena, and on the construction and uses of physical instruments in their application to physical chemistry, on the methods of differential and integral calculus, and on the theory and applications of mathematical statistics, the latter of which will treat of the application and modern mathematical methods of dealing with statistical data in social, educational, economic, and physical problems. In the metallurgy department, in addition to the ordinary courses of instruction in general metallurgy, special courses of an advanced character are provided on gold, silver, and allied metals, on iron and steel, on metallography and pyrometry, on heat treatment of iron and steel, on mechanical testing of metals and alloys, on mining, mine surveying, and on mineralogy.

THE director of technical instruction in the Transvaal, at a conference held in Pretoria in November, 1913, on technical, industrial, and commercial education, has made a thoughtful contribution on technical education as it affects the training of the boy for industry ("The Trades School in the Transvaal." By W. J. Horne. *South African Journal of Science*, August, 1914). Naturally he deals with the peculiar conditions of industry in South Africa, having regard to the large employment of native labour, the special and sporadic character of the industries and the large use of automatic machinery. Whilst expressing the belief "that human nature can be ennobled by the organisation of industry in the service of education," the author deals rather with the training of the boy outside the industry, and attempts to show the possibilities of preparing him from quite an early age for some specific craft chosen as his future occupation. The type of school advocated is an apprenticeship school in which the boy is kept at work, including short breaks, for forty-seven hours a week, of which considerably more than half is workshop practice. The course extends over forty-eight weeks of the year, and is continued for three and a half years, payment being made to the pupil ranging from 8*d*. to 1*s*. 9*d*. per diem according as the pupil is graded. Little is done to ensure the general cultivation of all the child's faculties. He is regarded as the human factor in the industrial machine; only utilitarian ends are sought; not his own uses, but the uses of an industrial society are the aim. The employer is not regarded as having responsibility for the training of his employés. He must have them ready trained or simply as labourers. The author reviews the position of the trades school, in which theory and practice are taught—the industrial school exclusively practical—the manual training school which provides for the due training of all the child's faculties irrespective of future calling. The policy and methods of the trades school as here advocated will scarcely commend themselves to thoughtful British educationists.

THE new session of the Battersea Polytechnic opened on Tuesday, September 15, and particulars of all the courses and classes are given in the calendar of the Polytechnic. The following sections of the work are deserving of special notice: Full-day and evening courses in preparation for the intermediate and final degree examinations in science, engineering, and music are offered. In the day technical college full-time courses are arranged in mechanical, civil, electrical and motor engineering, architecture and building, chemical engineering and art, the courses covering a period of three or four years, at the end of which time students passing the necessary examinations are awarded the Polytechnic diploma. There are also full university and diploma courses in mathematics, physics, chemistry, botany, etc. Concurrently with the diploma courses, students can prepare for and take the degree examinations in science and engineering of the University of London. The training department of domestic science offers two-, three- or four-year courses in preparation for the teachers' diploma in domestic subjects, and the commerce department gives a course extending over two or three years in preparation for civil service and other examinations, and for secretarial and general business appointments. The physical training department for women offers a course extending over three years, and prepares students for posts as teachers of physical training, drill, gymnastics and games. The department of hygiene and physiology, which is housed in the fine block of buildings recently presented by the Drapers' Company, provides complete and comprehensive courses in the following sections: combined course of training for women sanitary inspectors and health visitors, courses for the higher and lower certificates in hygiene, and the course for the lower certificate in physiology. In view of the increasing attention which is being paid to the health and welfare of the community, this department has a wide and ever-growing sphere of usefulness before it.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 31.—M. P. Appell in the chair.—G. **Bigourdan**: Observation of the eclipse of the sun of August 21, 1914. The times of the commencement and end of the eclipse were observed under unfavourable conditions.—E. **Vallier**: Internal ballistics. Various formulæ from the recent work of N. Zaboudski. Experiments on the gas pressures and projectile velocities in 3-in. (76·2 mm.) cannon. Approximate formulæ are deduced for the velocities and pressures as functions of the weight of the explosive, weight of the projectile, length of the powder cham-

ber, and thickness of the band of explosive.—Kr. **Birkeland** and M. **Skolem**: Calculation of the lines of equal intensity in the zodiacal light, on the supposition that it arises from the light diffused by a nebula of electrons or of radiant matter of solar origin. The formulæ deduced are illustrated graphically in seven diagrams.—H. **Bourget**: Partial eclipse of the sun of August 21 observed at the Observatory of Marseilles. The first and second contacts were observed under good conditions.—D. **Saint-Blancat** and L. **Montangerand**: Observation of the partial eclipse of the sun of August 21, 1914, at the Observatory of Toulouse. The times of first and second contacts are given.—I. **Tarazona** and V. **Martí**: Observation of the eclipse of the sun of August 20–21, 1914, made at the astronomical observatory of the University of Valentia (Spain).—J. J. **Landerer**: The total eclipse of the sun of August 20–21, 1914.—L. **Bouchet**: New determinations of Poisson's coefficient for vulcanised india-rubber. The pressures were produced by electrostatic means. The value found for Poisson's coefficient was appreciably equal to 0·5, signifying that india-rubber is incompressible.

BOOKS RECEIVED.

Smithsonian Miscellaneous Collections. Vol. lxiii., No. 7. New Subspecies of Mammals from Equatorial Africa. By E. Heller. Vol. lxiii., No. 1. Hodgkins Fund: Atmospheric Air in Relation to Tuberculosis. By Dr. G. Hinsdale. (Washington: Smithsonian Institution.)

Pendlebury's New Concrete Arithmetic. By H. Leather. First to Fifth Years. (London: G. Bell and Sons, Ltd.) 4*d*., 4*d*., 4*d*., 6*d*., and 6*d*.

British Association for the Advancement of Science. Australian Meeting, 1914. Handbook to Victoria. By A. M. Laughton and Dr. T. S. Hall. Pp. xvi+382. (Melbourne: A. J. Mullett.)

Brown's Marine Electrician, for Sea-going Engineers. By A. E. and A. H. Larkman. Pp. xv+244. (Glasgow: J. Brown and Son.) 5*s*. net.

Bacteria in Relation to Plant Diseases. By E. F. Smith. Vol. iii., Vascular Diseases (continued). Pp. viii+309+47 plates. (Washington: Carnegie Institution.)

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